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SPACE, PLACE AND DEMATERIALIZATION

Before the advent of recording technology, music was passed on and taught through an oral tradition and later as written performance instructions. It could only be experienced by hearing somebody sing or play an instrument in real time and real place. The complexity of the music was limited to the player's abilities, the diversity of the music to the instruments at hand and the availability of the music to the musician's presence and willingness to perform. When recording technology and radio broadcast were invented, sound became independent of both time and place, and also – except for a musician playing in solitude – independent of social setting. Accessibility to a vast variety of sound and music opened up for a greater and more diverse audience, both for enjoyment and for learning through repeated listening and imitation.

With the dissemination of recorded music on sound storage media music became a tangible commodity that could be bought and sold and an object that could be owned, shared and cherished. This laid the foundation for the music industry, which largely has shaped the directions of technological development as well as financial models and legal restrictions for the music community at large. Democratization of dissemination of music over the Internet¹ is challenging the traditional model in various ways and on various hierarchical levels in the creation and production of music of many genres.

This essay focuses primarily on implications developments in audio technology, sound carrying media and distribution formats have for the production and dissemination of *electroacoustic music*, and particularly *spatial* elements of electroacoustic music – an aspect that in its compositional and aesthetic significance is unique for this genre. The discussion provides a historical perspective and ties technological development to changes in musical production, listening and use.

Electroacoustic musics

New tools and technologies often give rise to new musical genres and techniques for composition, production and performance as well as changes in ways of relating to and using music. Electroacoustic music² depends on technology for its existence. It is a genre that could only emerge when means to make and manipulate sound recordings became available for artists to use. In the early days of experimentation, this meant recording or making patterns onto optical sound film,³ cutting individual shellac discs or recording onto and manipulating magnetic wire and tape. Recorded sounds were integrated into instrumental works already in the 1920s,⁴ but the musical foundations of what eventually led to the genre of electroacoustic music were laid earlier with the breakdown of tonality and introduction of increasingly complex sonorities in acoustic music combined with the Futurists' and Dadaists' use of noise and industrial and everyday sounds in sound art and poetry. Most historical accounts, however, date the origins of the electroacoustic music genre to radio engineer Pierre Schaeffer in Paris, France, in the 1940s, and his compositional work with recorded sound as well as his extensive theoretical investigation into listening to and manipulating recorded sound. After WWII, the increased availability, access and ease of use of audio technology opened up a new world of sound, both for capturing and for processing, and composers could finally work with sound directly rather than indirectly by merely providing instructions for music performers to carry out.

Electroacoustic music has from the beginning been a multi-disciplinary field, combining the efforts of artists, technology experts and scientists. Development of tools for electroacoustic production was for a long time the domain of academic and research institutions – and eventually dedicated computer music centers – mostly due to technology-intensive requirements for creation and performance, but also due to the valuable collective knowledge and creativity provided by such communities. Faster, smaller and cheaper computers for home use have made tools for creation widely accessible, and with a fast growing market for home music production most music-technological development has become highly commercialized and now largely takes place outside of communities traditionally identified by the electroacoustic music genre.⁵ With easy access to such tools for musicians of a variety of musical backgrounds and ambitions, paired with inexpensive and simple ways of distributing and sharing over the Internet, electroacoustic techniques for music production have become the foundation of genres

far beyond traditional electroacoustic music, something which has contributed to a blurring of genres and given rise to a broader palette of artistic expression.

The relatively recent and rapid evolution and proliferation of technology-based musics have come largely as a result of dematerialization of the sound medium, and could only have happened in tandem with reduced size and cost of tools for production and reproduction. The ability to work with sample-level accuracy and process and copy audio files without loss of quality or addition of tape-era generational marks such as hiss and distortion have provided means to work with sound in highly sophisticated ways with relative ease. Internet distribution, whether commercial or communal, has made available music and sound for artists to hear, use and be inspired of that otherwise would have had limited geographical and societal reach. From a compositional point of view, dematerialization opened for a radical new level of artistic possibilities and opportunities. The influence this has on musical genres is mutual – albeit with varying degree of benefit as well as varying sense of affinity among musical and artistic communities.

Musical space

Spatial aspects of sound and sound relationships were an essential part of the electroacoustic music genre from its very beginnings. The first public concert of music composed entirely of recorded sound sources, organized by Pierre Schaeffer and Pierre Henry in Paris in 1950, utilized manually controlled sound projection on a 4-channel loudspeaker system, and in 1952, the first 8-channel surround sound composition, John Cage's *Williams Mix*, was premiered. These early works, however, were played back on multiple mono tape decks with no synchronization among the tracks. The first multitrack surround composition was Karlheinz Stockhausen's *Gesang der Jünglinge* from 1956, originally performed on five loudspeakers, but mixed down to become a four-channel composition. Multi-channel (surround sound) composition has since become commonplace in a variety of formats and configurations, and the praxis of *sound diffusion* – where the composition's inherent spatial and dynamic properties are articulated and enhanced and the spatio-structural content of the work is underlined by physically distributing the sound around in the listening space – has developed into an essential and integral aspect of electroacoustic music in concert.

Space is a ubiquitous element of sound, yet one that has gained limited awareness among practitioners and audience alike as an essential component of music and listening. Spatialization can be utilized to integrate parameters such as placement, envelopment, movement, opposition, enclosure, distance and intimacy into the musical structure as a device that contributes to the communication and meaning of the work to a degree on par with more conventional musical devices such as timbre, dynamics and tempo. Although examples of spatialization can be found in instrumental and choral music dating several hundred years back, it was not until composers could create music specifically for loudspeaker performance that a broad, systematized effort was made to integrate space as a structural musical element. Spatial considerations in the composition process – the choice and arrangement of sound material in terms of spatial characteristics and associations – are fundamental to the creation of the electroacoustic work. A musical space is composed of spatial information intrinsic to the sound material itself as well as virtual space and spatial discourse made up by the arrangement of the sound material. Size and layout of virtual spaces, use of distance and movement, integration of familiar environmental cues and the nature of spatial interrelations among the sound materials are powerful and flexible tools for musical expression.

With space having such a significant musical function, the spatial potential of the playback system is of particular concern for the composer with regard to successfully conveying meaningful spatial elements to the listener. The spatial experience is quite different in a concert hall with a large multi-loudspeaker diffusion system than it is on a home stereo system or on headphones, and similarly, quite different in the highly controlled – and, most commonly, homogenous – composition studio environment than in the concert space with its multitude of variables in terms of size, acoustics, type of sound system and audience seating. Many of the factors related to spatial portability have been an issue in electroacoustic music for a long time, and the potential of keeping the entire production chain from composition to concert presentation in the digital domain and the unprecedented flexibility and control this unlocks are therefore very welcome.

Dematerialization offered by new technologies puts virtually no limit on the number of audio channels. The electroacoustic music genre in concert is not inherently tied to standardized channel numbers and loudspeaker configurations. At its core, the established custom of the acousmatic⁶ music concert fuses aspects of the conventional music concert and the site-specific sound installation in that

a front-facing audience configuration is combined with a number and placement of loudspeakers that specifically match the individual performance space and the music to be performed. Differences in spatial potential of different listening spaces⁷ pose different possibilities as to how the music acoustically reaches the listener and ultimately how the music is perceived and experienced. The best result comes from the best possible combination of music, playback system, listening environment and listener position.

However, flexibility has traditionally come at the cost of accuracy. Unlike site-specific sound installations, where the artist ideally has the luxury of tailoring the choice and placement of sound system to the specific site and sole audio content, electroacoustic music concerts typically involve a selection of compositions by different composers that often require different spatial treatment. The electroacoustic music canon has, however, established two approaches for concert performance: multi-channel works for more or less unmodified playback and stereo-based compositions intended for active sound diffusion. Within these two categories there are still a great many variations.

Sound diffusion is the act of performing the acousmatic work by “spreading out” the (typically) stereo composition on a multi-loudspeaker concert sound system in order to articulate and enhance dynamic and spatio-structural elements that are composed into the work. In a way, sound diffusion can be regarded as an extension of, or even a completion of, the composition process, where the stereo version provided on the sound storage medium is merely a point of departure for the work as it is intended in its true environment: a fully enveloping sound field in the concert hall by means of the sound diffusion system. The diffusion of an electroacoustic composition is in its essence specific to a particular sound system and concert venue. Sound diffusion is a site-specific, hands-on musical performance that has to be prepared for and rehearsed in the particular listening space of the concert so that the spatio-structural features of the work can be put across to the listeners in the best possible way in that particular space. This approach has the advantage of not being tied to specific shapes or sizes of concert halls or a specific number and placement of loudspeakers (a number which can range from a modest eight to well into the hundreds). The spatio-structural composition of the work provides the guideline, but the details for the performance lie in the combination of work, performance space and diffusion system. When sound diffusion is carried out successfully, it adds a choreography and dramaturgy to the

sound material that underlines the substance of the work, and additionally may cause the loudspeakers to appear transparent to an extent where they are hardly noticed as the actual sound radiators, and thereby facilitate a multi-dimensional sonic experience which traditionally has been unique to the genre of electro-acoustic music.

For multi-channel works, the prohibiting factor for flexibility in terms of channel numbers and configuration has until recently been on the hardware side. This is true both for production as well as for concert presentation. The introduction of the 8-channel ADAT and DA-88 cassette technologies in the early 1990s made portability between composition studio and concert venues significantly easier compared to the previous standard of multi-track reel-to-reel tape. However, it was not until affordable multi-channel computer audio interfaces were available and computers became the concert playback device of choice that a major leap took place with regard to popularity among composers to create multi-channel compositions. Pair this with the availability of surround-sound home (theater) listening systems, and the incentive for creating multi-channel works has increased significantly.

Unlike stereo, which is long established as a standard format and dominating focus for equipment manufacturers for both domestic and professional markets, the multi-channel format has not become anywhere near as ubiquitous, despite the film industry's effort to promote the ITU 5.1 surround standard for home audio (albeit as a byproduct of home cinema). For electroacoustic music and sound art where space is fundamental, the rigidity of the composed musical material on fixed, channel-limited storage media could pose an obstacle for successfully conveying spatio-structural elements in places outside of the composition studio. Apart from 5.1, which is a home-listening format not suitable for large-space playback, the nearest to an established standard for multi-channel works is the 8-channel surround sound composition for a circle of eight loudspeakers, but even there, there is disagreement on the configuration: one central loudspeaker in front and back or a pairwise arrangement front to back, and which speaker gets channel number 1, and are the channel numbers counted clockwise or anti-clockwise, and how big of a circle? For concert performance, the possibilities that digitalization and dematerialization of sound present for multi-channel works are therefore tremendous. It is obvious that the issue of channel order and routing is easily solved by working with sound files rather than tape tracks, but the

increased flexibility offered by dematerialization of sound-works in terms of manipulability of compositional components goes significantly beyond that.

The main advantage of flexibility in the context of concert performance is adaptability to a variety of sound systems and performance spaces. Multi-channel compositions can be tailored to a particular listening space, sometimes by duplicating audio channels in order to increase the sound coverage to accommodate non-standard audience positioning, other times by combining channels into fewer loudspeakers in order to concentrate the sound image to one or several smaller areas, in yet other times by using a combined approach of a “fixed” surround sound base and a more dynamic diffusion component performed in real time. Further, sound diffusion can be carried out with more than two source channels, sound can be diffused as “clouds” to sets of loudspeakers rather than each channel to an individual loudspeaker, or part or all of a sound diffusion can be automated, incorporating necessary adjustments in real time to variations in acoustics between rehearsal and concert as a response to presence or absence of an audience. Wilson and Harrison (2010) describe various approaches for composing in stems in order to increase adaptability to different sound system arrangements and audience positioning, where elements that need to be treated discretely in the performance situation are separated out in the composition process with flexibility of final spatialization in mind. Adapting a work to a specific sound system and listening environment adds complexity and requires significant planning, time and practice to be carried out successfully, and may be difficult to achieve with a high level of satisfaction unless the specifics of the listening space are known beforehand and the composition format follows a relatively common configuration. Even then, if the work deviates from any of the conventional configurations, a successful transition from composition studio to listening space may be problematic, and an integrated allowance for spatial compromise in the composition may be beneficial.

A different approach, then, if the concept of the work demands a composed space of such complexity and precision that the influence of the listening space must be reduced to a minimum, is to compose with a surround-sound panning technique that lends itself to faithful reproduction with a relatively high level of accuracy on a variety of playback systems. Near limitless channel numbers, complete channel separation and exact synchronization among channels have given rise to a variety of coding techniques for surround sound, such as Vector-Based

Amplitude Panning, Distance-Based Amplitude Panning and Directional Audio Coding, as well as to a renaissance of the Ambisonics⁸ technique, which, depending on the order of spatial resolution one chooses to work with, requires 4, 9, 15, 24, 35, 48, 63 or more encoded audio channels as the source, while the number of actual playback channels in the decoding stage can be set to match whatever number and configuration of loudspeakers are available. Such an approach may be particularly advantageous if the composition incorporates, for instance, natural sounds or soundscapes recorded as surround sound at the source that need to be preserved as such in the final work. The possibilities are plentiful, however not yet necessarily simple.

Musical place

While means for production and distribution have been made accessible for many, resources required for public performance on typical multi-loudspeaker diffusion systems still remain within limited reach, as the discussion above indicates. However, democratization of means for production and distribution has inspired new target spaces for performance and playback, and changes in use of music that in large part have come from rapid proliferation of mobile playback devices and omnipresent access to the Internet have led to different listening habits and shifts in musical needs. For everyday music listening, these changes have resulted in headphones, laptop speakers and audio docking stations becoming the predominant playback systems for the average music consumer, and access to an enormous amount of music via the Internet has made the soundbite and word of mouth in the form of status updates, comments, “shares” and “likes” on social networking and music streaming sites almost essential for gaining attention and reaching an audience. In terms of conveying composed musical space, new places for listening present a new set of challenges for distributing and presenting music outside of the concert hall, but also opens for new possibilities for spatial transportability and spatial accuracy.

In the current climate of ultra-portable playback devices, headphone listening is most commonly a mobile listening experience that takes form as private listening in public places. Portable playback systems have been around almost as long as playback technology itself, but it was not until the introduction of the Walkman in the 1970s that music in earnest became private in public in a profound way. Portable music technologies have gone through a variety of formats,

from gramophone, reel-to-reel tape and boombox – all relatively bulky and primarily loudspeaker-based – to smaller headphone-based playback devices for cassette, MiniDisc, CD and today a plethora of more or less lossy computer file formats, most restricted to mono or stereo, but also a few with multi-channel capabilities. The current dominant playback device is the mobile phone, which combines local storage of often thousands of “songs” in addition to further access to music on the Internet and cloud storage as well as via one-to-one sharing with other mobile phone or computer users, accompanied by text-based or voice-based commenting and messaging. This evolution will no doubt continue with other formats, storage systems and streaming methods dominating in the future.

The easy portability of music as intangible, abstract pieces of information breaks down the notion of the musical place. Listening on headphones has become an activity suitable for any place and any circumstance. In a sense, this indicates an increased importance of music in everyday life. However, because music listening is such a ubiquitous pursuit, music often functions more as a near-constant background that is merely heard rather than something that is actively listened to. Active listening demands priority of hearing and directed attention, and cannot easily be a component of a multi-tasking activity, such as while carrying out chores or navigating city streets. That is not to say that complex musics cannot function as a satisfactory background – that all depends on the listener and the listener’s intimacy with the music – but it is hardly a circumstance in which to unlock structural intricacies in challenging works. Still, as sales of conventional home listening systems dwindle in favor of headphone-based playback devices, there is good reason to take headphones seriously as a private listening space also for music demanding concentrated listening.

Unlike the concert situation, where each audience member is oriented differently toward the position of the loudspeakers, with the result that each receives a different spatial image, headphone listening bypasses room acoustics and is unaffected by listening position. Each listener hears the same spatial information, and the spatial composition of the work does not have to be open for compromise to the same extent in order to be conveyed in a satisfactory way. (It is important to note, though, that we also sense sound waves with our bodies in conventional, open-air listening, a phenomenon that is lacking with headphone listening.) With increased sophistication and processing power in portable technology, to the extent that the individual listener’s own anatomy⁹ can provide data for the

best possible, personalized decoding, playback of two-channel binaural sound for headphones is a relevant option. Binaural technology can open up the virtual sound field of the headphone space and reproduce highly realistic spatial cues and spatialization that can excite an experience comparable to that of a sophisticated sound diffusion heard from the best seat in the house, making spatialization previously restricted to expensive, large-scale loudspeaker systems available anywhere.

It cannot be ignored that properties of the listening environment picked up by vision and other senses have an influence on the musical-aesthetic experience. Such properties can affect the listener's ability to attend to the music in a concentrated manner, and may underline or contradict spatial cues as well as other elements composed into the musical work. The mobility of headphones as a listening space implies that any environment can be a listening environment. The listener can choose music for a specific place and situation or choose a place for specific music. The mobile listening space becomes a way to provide a soundtrack to any circumstance, so that music can be used to enhance or change the experience of an environment or a situation, such as a sunset or a spectacular view, to shut out or mask the ordinary sound of a place, whether city streets or an indoor work environment, or to replace the quiet soundscape of a rural area to underline or incite a certain mood. Such a linking of music to place and event adds spatial and situational associations to the music in a way that in effect personalizes the meaning and function of the music, and allows the listener to integrate music into their lifestyle to a degree not previously possible.

End note

In a time of hyper-mobility, ever smaller playback devices and, perhaps above all, impatience, where is the place for a resource-demanding genre like electro-acoustic music?

A fast-paced culture dominated by text snippets, soundbites and rapid visual stimuli offers limited time, opportunity, tolerance and ability to devote undivided attention to listening. Art that puts particular demands on concentrated listening increasingly becomes a marginalized niche. Still, any genre can only survive and evolve by attracting new audience members and presenting opportunities for new artists. Music distribution formats are ideally chosen on the basis of artistic needs and desires, but are in reality mostly dictated by genre conven-

tions, distribution channels and consumer expectations. Today, music is most often discovered by hearing a soundbite here and reading a comment there, guided by hyperlinks and accessed by a simple touch or a click. The shift toward online distribution and communication has led to more of many things – more musics, more listeners, more competition. With a change in communication channels, communities are changing as well. The global reach can afford genres to become more narrow and specialized while still enjoying a larger audience. In a sense, the world becomes smaller and larger at the same time.

In the big picture, admittedly the electroacoustic music genre is a marginal genre. However, while it is no longer at the forefront of techniques for timbral treatment and audio quality, the large-scale surround sound experience of the electroacoustic music concert is still unique for the genre. Surround sound is standard in modern cinema, so the surround sound experience is by no means unknown to the broader audience, but the extent and depth of integration of the encircling sound field with the musical content as well as the size and dynamism of a typical diffusion system are not found in other genres. Many of the means that were pioneered, developed and brought to maturity by the electroacoustic music community – technology as well as processing techniques – have been adopted by other genres, some of which enjoy a significantly broader listening base. Among other things, this has led to greater tolerance and openness among both artists and listeners toward sound materials that in a musical context previously were largely exclusive to electroacoustic music. A similar appreciation of the musical-communicational potential of space, despite its ubiquitous nature, has not reached the consciousness of the broader audience yet. The potential for an expanded audience base is nevertheless apparent.

Music as a private listening activity, where the place for personalized listening is no longer limited to the private home, offers more opportunity for diversity and immersion than ever before. Spatial and situational context and association presented by mobility and opportunity for individually curated soundtracks that can either be mapped out in advance or arranged or modified on the go, tie space and spatial characteristics to music in a powerful way. Musical space, integral as a musical-structural device or external as a place that in combination with specifically chosen musical work enhances the experience of a space, remains a powerful tool for musical expression and an essential component of musical experience.

1. Online democratization is, however, already under threat by the current, rapid commercialization of Internet infrastructure.
 2. Electroacoustic music can refer to any musics that require electroacoustic means of any kind and to any extent for production and/or performance. However, the electroacoustic music genre is, as any genre, defined within a certain framework of aesthetics and conventions. In this essay the term is used in reference to the electroacoustic music genre, including anything that carries related labels such as *musique concrète*, *elektronische Musik*, *computer music* and *acousmatic music*, without diminishing the specific historical and philosophical differences among them. I primarily discuss music composed in non-real time onto a fixed medium.
 3. An early example is Walter Ruttmann's radio art work *Wochenende* from 1928.
 4. For instance Ottorino Respighi's *Pini di Roma* (1924) and Kurt Weill's *Der Zar lässt sich photographieren*, op. 21 (1927).
 5. To an extent, the free software movement, primarily Linux users, maintain the community-driven development of free tools for music production.
 6. The term *acousmatic* refers to a listening situation where the sound source can be heard, but not seen. Music and sound played over loudspeakers is the most common example. *Acousmatic music* has become established as the genre designation of electroacoustic music composed onto a fixed medium specifically for listening solely via loudspeakers.
 7. With *listening space* I mean the combination of sound playback system and room. For details, see Henriksen (2002).
 8. The Ambisonics technique was developed in Britain in the 1970s, but despite a number of music releases on quadraphonic records it never became a commercial success.
 9. Successful binaural decoding integrates the individual's *head-related transfer function* (HRTF) to take into account the unique auditory filtering caused by reflections from the individual's head, pinnae and torso. Without it, the experience may be that sounds are located inside or very close to the head or the front-rear sound image is reversed.
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