

SOME CONSIDERATIONS FOR SPATIAL DESIGN AND CONCERT PROJECTION WITH SURROUND 5.1

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ABSTRACT

This article describes the process of composing an electroacoustic music piece using a 5.1 surround sound system for studio monitoring and diffusion in a concert hall. Specific spatial ideas explored in the composition of the piece are explained in connection to the possibilities offered by this system, as well as to its limitations. Considerations are outlined regarding the quality of the spatial performance of the system in a concert hall as compared to its performance in a studio in the compositional process. Some conclusions are drawn as regards limitations and advantages of surround 5.1 systems for electroacoustic music composition and some suggestions are made for a more effective concert performance.

Keywords – Spatial design, surround, sound projection, composition, electronic music.

1. INTRODUCTION

There has been an increase in the use of multi-channel systems in the last years due to more accessible equipment prices as well as due to more refined possibilities of working with spatial design which these systems and related software offer [1, 2, 3]. This encouraged many electroacoustic music composers to start working actively with systems such as surround 5.1 as a way to expand the possibilities for the use of space in their music. But, when working with systems that offer more tools for spatial design such as surround 5.1, do we really obtain a complete control of the spatialisation or do we put more limitations than advantages to the compositional process? And what are the good and the bad attributes of 5.1-channel systems for music creative purposes that a composer should be aware of when playing a piece in a concert hall? Considering these questions as a motivation, the first goal of this work was to study the limitations and advantages of the surround 5.1 through the compositional process of a piece of electroacoustic music, with some specific ideas for the spatial design in mind. A second goal of this study was to try to understand the limitations of the diffusion of electroacoustic pieces in surround 5.1 in concerts as compared to the original studio spatial design.

2. SPATIAL DESIGN OF THE PIECE

2.1. Inspiration

The piece *Plastiches* was conceived as an exploration of different approaches to space, using sonorities of plastic sources and foams recorded in an anechoic chamber. Two types of sounds were used for the piece: natural impulsive sounds from the mentioned sources and convolved continuous sounds obtained from the same sources. These two types of sounds were used as a basis for the design of the two very distinctive parts of the piece. The spatial design was conceived from the start in surround 5.1, trying to achieve particular goals and giving it an active role in the compositional process.

An initial inspiration for the use of space in the piece were ideas developed by the composer Trevor Wishart while working with quadrasonic systems, exemplified in his book *On sonic art* [4]. It was interesting to test some of the ideas designed for symmetrical quadrasonic systems in the surround 5.1 format and see how they could be developed. Ideas related to the use of space in different forms such as motions, trajectories, frame rotations, temporal developments and interactions were considered as a basis for the composition of the piece in terms of spatial and timbral evolutions.

A second source of inspiration for the spatial design of the piece were the possibilities for spatial allusion brought about by the quality of the sound material used in the piece, in this case anechoic recordings. The diversity and the dry quality of these recordings led to a particular approach to the use of space. By manipulating the dynamics and also the positioning of sound it was intended to create perceived spaces with some relation to particular situations that could be perceived as allusions.

2.2. Use of space in the piece

Space was approached in the piece from different perspectives, trying to work with it structurally as well as organically. The piece is structured in two parts, following the idea of a timbral and a spatial counterpoint between sounds originated from plastic

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sources and foam sounds. Different types of spatialisation techniques were developed throughout the piece according to the type of material used, trying as much as possible to bond timbral and spatial gestures with a detailed use of the automation of the surround parameters in the mix. The first main idea for spatialisation to be developed in the piece was that of motion and spatial interaction of elements in a defined sonic space, the space created by the surround 5.1. Trajectories of particular sounds in the horizontal plane were designed and automated following fusions and contrasts in timbre of particular sounds. This was done assuming, as with quadrasonic systems, a discrete space with the listener in the middle where different possibilities for movements and interactions could be designed in detail in a kind of grid [4]. Figure 1 shows the grid with spatial positions as seen in the software for the automation of the surround.

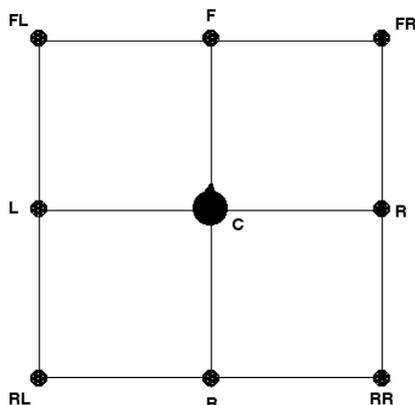


Figure 1. Grid with spatial positions (F: front, FL: front-left, FR: front-right, C: centre, L: left, R: right, R: rear, RL: rear-left and RR: rear-right).

The second main idea to be developed was to try to create non-conventional evolutions of the use of space by employing speakers as discrete sources that could help to break the spatial perspective in multiple images and would make the listener lose the sense of a purely stereo focused composition. This approach, well known by composers who work with the multi-channel format, allows a great deal of flexibility and lets the space play a more active role in a non-conventional manner [5]. Some of these spatial developments were obtained by the rotation of the listener's axis in relation to the speakers, by spatial counterpoint through the alternation of distinctive sound material between speakers, by rhythmic associations of timbre and space, and by developments of long continuous convolved sounds played by particular pairs of speakers.

3. COMPOSING USING THE 5.1-CHANNEL SYSTEM

3.1. The 5.1 surround system

The 5.1 surround system was developed for cinema applications as a front-orientated sound stage with

stereo effects or room ambience [6, 7]. The system consists of a conventional stereo pair in the front, with a central speaker in the middle, two speakers at the back and a subwoofer. This system can also be considered as a 3-2 stereo configuration, with a stereo pair in the front and a stereo pair at the back. The subwoofer speaker is normally located in the front, close to the central speaker. Figure 2 shows the positioning of loudspeakers in the surround 5.1-channel system [7].

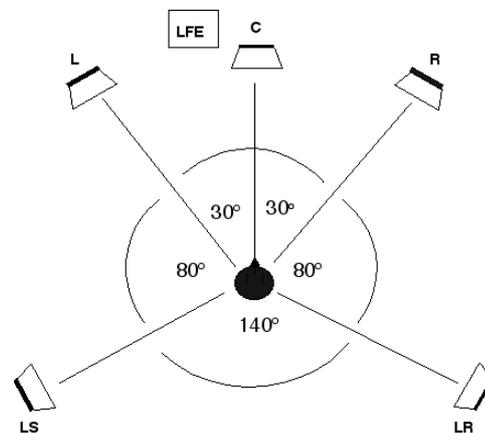


Figure 2. Disposition of loudspeakers in a 5.1-channel surround system.

3.2. Pros and cons for musical spatial design

As a way to ensure an effective use of space in the piece with the possibilities of the 5.1-channel surround system it became important to understand the advantages and the limitations the system poses for the development of the ideas previously mentioned. As to the positive aspects of the surround 5.1 system, it can be stated that the system offers a number of tools to expand the possibilities for musical spatial design such as the possibility of creating very stable stereo images with the support of the central loudspeaker, very rich and advanced possibilities of automation for the spatialisation of the sound image, as well as the possibility of creating a very effective sense of surround in the listener with the help of the rear speakers. Another advantage of 5.1-channel systems, less exploited for musical purposes, is that a carefully adjusted mix can facilitate an aesthetical approach towards spatialisation by combining the stereo and multi-channel techniques as mentioned previously. This means that for some purposes one can work with a conventional stereo image reinforced with the sound of the rear speakers and for others one can treat all the speakers of the systems as discrete sources that can be used to create contrapunctual and independent spatial developments, not necessarily based on a stereo image but on a number of discrete independent sources. To achieve good results from the combination of both techniques a considerable amount of time needs to be spent in order to understand perceptually how the system works in terms of spatial distribution as well

how one can develop interesting contrasts and fusions of the two techniques

Once the advantages of surround systems have been presented, it is also important to mention that 5.1 surround poses serious limitations to a spatial design for musical purposes where the space is to be integrated effectively in the composition. The first clear disadvantage of surround 5.1 systems encountered in the process of composing the piece was the extreme focalisation and timbral colouration of sound in front of the listener produced by the contributions of the central speaker. This makes the mix brighter than usual and creates a different perspective for the spatial developments in the frontal axis, making the stereo mix more focused in the centre with fewer possibilities for movements to the extremes. A second disadvantage, less obvious when monitoring in the studio as it will be explained later, is the spatial discontinuity at the sides of the system between the three frontal speakers and the two rear speakers. It becomes clear after spending some time monitoring the system that it is quite hard to create an integrated convincing spatial design which breaks the disposition of the two stereo systems (3+2) with holes at the sides of the listener. Cinemas have also experienced this problem with multi-channel systems. As a result, multiple speakers are used at the sides of the hall and also at the back in order to reinforce the sound of the two rear channels [8].

At a macro level, besides the above mentioned disadvantages clearly related to the architecture of the 5.1 surround system, a recurrent problem encountered while designing the piece with different software was the imprecise correspondence between the visual movements of the sound image shown on the spatialisation automation screen and the actual perceived movement of sound inside the speaker configuration. This paradox creates a peculiar illusion of movements that do not really sound positioned as it is shown visually, which implies re-adjusting the mix following one's aural perception rather than the movement of the sound image provided by the software used for spatial design. In this context the discrete space shown in Figure 1 (which is the one shown on the software screen) becomes just a vague reference that does not really correspond in detail to the way we listen to the sound located in the geometrical space. After a considerable amount of practice with the system it became clear that it is important to define certain limits for the movement of the sound image, with movements and positioning occurring within the grid, in order to get an integrated sound and not sounds that focus on the speakers. By carefully listening to the movements of the sound image some limits of the discrete space mentioned can be set where movements and trajectories can be integrated and developed effectively. Outside these limits the sounds tend to focus on the speakers as point sources and, as a result, the whole stereo image is broken. Figure 3 shows the original discrete space

shown in Figure 1 with the limits for the effective spatial integration of sound.

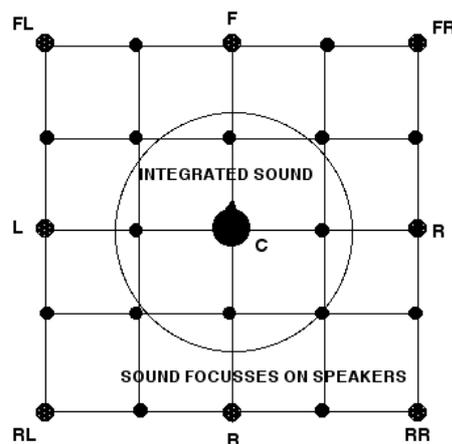


Figure 3. Grid with spatial positions with two areas where there is integration of sound (inner) and where the sound is focused into the speakers (outer).

4. CONSIDERATIONS FOR THE DIFFUSION OF THE PIECE IN A CONCERT HALL

After the spatial design of the piece in the studio was finished the piece was tested and adjusted in the Arthur Sykes Rymer Auditorium at the Music Department of the University of York using a 5.1-channel surround system similar to the one in the studio [9]. The type of loudspeakers used in the concert hall was the same brand as the ones used in the studio, but in larger models.

4.1. Re-mixing the piece in a concert hall

The mix created in the studio was played in the hall and re-mixed by adjusting the automation of the spatialisation through a process of repeated listening. When playing in the hall the mix done in the studio, different issues were identified concerning the quality of the spatialisation and the overall sonic experience. The first impression was that in the hall it became easier to distinguish when sounds integrated together in space in a coherent way and when sounds focused into the speakers, breaking the unity in the spatialisation. The distance between the speakers and, above all, the absence of sound sources at the sides made the spatialisation of the studio mix quite fragmented in the hall, adding a sense of discontinuity to the spatial gestures. It became very obvious to the listener that he/she was confronted with two stereo mixes overlapped, one in the front and one at the back (3+2). It also became clear that the sense of unity in the spatialisation achieved in the studio was lost in many sections of the piece and that impulsive sounds focused more into the speakers when played in the hall.

The second problem encountered while playing in the concert hall the mix done in the studio was that the balance in terms of timbre changed quite dramatically,

especially in the low frequencies where the proportions of the hall now seemed quite large compared to the ones in the studio. This could be compensated easily by boosting the level of the subwoofer channel and also by minor adjustments in equalisation.

4.2. Sound material, spatial approach and dynamics

Throughout the listening and re-mixing process it was very interesting to discover that continuous sounds could easily be spatialised and integrated in the hall with almost no adjustments. Just by balancing correctly the relation of the levels of these sounds in the front and in the back speakers, very convincing and detailed trajectories could be developed, crossing through the room in an almost unexpected and impressive way.

It was also interesting to notice that the possibilities of working with different spatial aesthetics, as mentioned in the previous section, become wider in the concert hall. Contrasts between independent spatial developments using the speakers as discrete sources and stereo images created with all the speakers could be done effectively by carefully adjusting the mix.

Another interesting issue noticed in the concert hall was that dynamic changes in the mix seem to work in a quite different way than in the studio, probably because of the larger dynamic range of the speakers. This implied that some adjustments needed to be done in the balancing of the piece in terms of intensity of the different sections that seemed to sound quite differently in the hall compared to the studio. The success of making a compact and integrated spatialisation of the sounds proved to be very dependent on the global intensity of the piece and its relation to the type of hall. Too high levels impoverish the possibilities for contrasts, making the mix exaggerated in terms of spatial gesture, while very low levels make it difficult to integrate the spatial and timbral details in the hall. A careful adjustment of levels for concert performances seems to be necessary in order to compensate for different types of room acoustics, especially between the front and the rear speakers.

5. CONCLUSIONS

The composition and spatial design of the piece *Plastiches* with a surround 5.1-channel system showed that the system has advantages and disadvantages that need considering in order to create a coherent spatial design in a music piece. It showed the importance of being aware of the limitations of the system, since the positioning of sound on visual interfaces can give an inaccurate perceptual idea of the movement of sound. The spatialisation also proved to be very dependent on the type of sound material played.

5.1-channel surround proved to have a potential for a compositional approach in which the spatial design can combine and integrate a multi-channel discrete source

spatialisation approach with the single image stereo approach.

Considering the diffusion of the studio-designed piece in a concert hall, one should be aware of the need for adjustments in the level of the piece as a way to preserve to a high extent the spatial design. One very straightforward adjustment is the one of the subwoofer channel as well as the balance between the level of frontal and rear speakers.

6. ACKNOWLEDGEMENTS

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