The implications of commercial 5.1 and 7.1 surround formats for computer music sound design: an environmental approach to aesthetics and practical techniques.

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Abstract

5.1 and 7.1 are standard and popular loudspeaker layouts, defined by the film industry and International Technical Union (Holman, 2001). In addition, the 5.1 format has gained considerable market ground by being available to end-users via the DVD medium. It is the purpose of this paper to explore practical ways in which composers working in electroacoustic and computer music might take advantage of these formats, as opposed to spatialisation methods which are often customised to the needs of individual works, institutions and venues.

The paper recommends an integrated, environmental approach towards mixing, and provides basic ideas as a springboard for composer experimentation in this growing arena. It is important to note that the future challenges of 5.1 and 7.1 probably do not lie in solving engineering problems: most issues presented here are conceptual, and concern the compositional reasoning behind the choice of positioning elements within in a soundfield. Whilst it is acknowledged that 5.1 and 7.1 sound projection is relatively low-resolution spatially, there are many compositional opportunities afforded by commercial layouts that should not be overlooked. This paper examines these issues, and is accompanied by surround audio examples on DTRS (or ADAT) tape.

1.0 Why spatialize music?

Before attempting to define any aesthetic considerations relating to 5.1 and 7.1 surround it is necessary to examine the need per-se to spatialize music. Two basic ideas lie at the root of modern spatialized music, although their specific applications may vary with the needs and requirements of individual composers. These are:

i) The creation of enveloping and aurally engaging environments, and

ii) musical choreography.

Subsidiary aims, such as allowing for greater audience coverage and the implications of any additional requirements of the medium (such as the placement of dialog in the centre speaker in film sound) are also important considerations.

1.1 Creating new environments

Surround sound systems are particularly adept at creating a sense of physical space in music (Schafer, 1973:15), and multi-speaker sound diffusion methods are often used to provide convincing re-interpretations of spaces, be they real or imaginary. Firstly, the use of recorded physical spaces can lend credibility to a compositional environment in a way that is not possible in stereo. I have termed this Reality credibility, which is examined in detail in a previous publication (Field, 2000:45). For a reproduced environment to appear convincingly natural (even if the end goal is a totally imaginary space), it is beneficial to work with material that has remained in the destination surround-sound format from the outset. Gibson (1966) demonstrates that environmental cues are paramount to our perceptual understanding of spaces. Extending this idea to soundscapes, it is the nature of the relationship between the sound-
source, and its environment which helps the listener identify how believable a space is. This idea is perhaps more important in surround than in stereo production, as it takes considerably more ‘data’ to assemble a convincing surround ambience over a multichannel rig than for a similar stereo environment.

1.2 Creating a coherent listening experience in 5.1

Panning mono sources can be a very effective stereo production technique: however, panning mono sources within a surround environment will invariably serve to highlight the empty space that surrounds them. Unless many sources are at the composer’s disposal, or this is the intended effect, coherency in the resulting soundfield will be improved by processing, manipulating and mixing surround material with a full compliment of channels. This has computational implications for even the most powerful of contemporary workstations.

It is tempting to view traditional studio practice, such as making spectral space in a stereo mix by using narrow band-pass filters on textures competing for spectral space (Elen, 1989:181) as being largely redundant in surround. Although a surround mix offers composers greater opportunities in the physical positioning of materials, it should be remembered that spectral space is a separate domain, and without appropriate spectral control even a texturally sparse surround mix can lack cohesion that would otherwise have been obtained by standard bandpass equalisation techniques. [Audio example 1]

Processing often commonly applied during mastering of stereo material also needs careful re-evaluation. For example, it is not always necessary to use compression linked across all 6 channels for 5.1 production. For example, as the LFE channel carries only low frequency effects, it would be particularly unwise to link the dynamics of this channel to the main channel’s full bandwidth programme material. Doing so would result in unintentional shifts in perspective within the surround environment.

1.3 Choreographing music

Our second aim of musical choreography is more complex. Importantly, it is not necessary to make sounds ‘dance’ as an end in itself. Exaggerated spatial movement, particularly over an extended time-scale is perhaps not a very productive spatialization strategy. In producing coherent soundfields, we must first examine the nature of the musical relationship between the constituent soundfields and the spatial environments which they occupy. It is this aspect of choreography, the relationship between object and space, that forms a powerful tool when considering the positioning of sound sources in 3D space.

A variety of relationships exist, as proposed by Wishart (1996:129).

| 1. Real sounds in real spaces |
| 2. Synthetic sounds in real spaces |
| 3. Synthetic sounds in synthetic spaces |
| 4. Real sounds in synthetic spaces |

Table 1: Space and object combinations. Adapted from Wishart (1996:129)

Working with these relationships, rather than the sounds themselves will yield new and productive spatialisation approaches. By ‘synthetic’, we are referring to sounds which are audibly not simple recordings of the real world – instead they have been processed or synthesised. When combining synthetic and real spaces, the result of the combination in cases 2, 3 and 4 is a predictably abstract environment. Sounds robbed of their context being to take on surreal qualities. To aid this perception, the positions occupied by those sounds within the soundfield can be adjusted.
to heighten discrepancies between nature and simulation.

When combining real-sounds with real spaces, one of two situations results. Firstly, the sound environment created may take on characteristics of the real. However, if the sounds are chosen selectively, it is possible to create a hyper-real, or ‘more real than real’ space. This has considerable implications for positioning objects in this case. Sounds would need to occupy positions in the soundfield that the audience would expect to find occurring in the real world. Once these relationships break down, then the space will be perceiveably synthetic, even though the constituent sound sources are natural. [Audio example 2].

Table II below shows useful outcomes for spatial positioning in a musical context within spatially low-resolution systems such as 5.1 and 7.1 [Audio examples 3,4,5]

- Demonstrate or effect structural change.
- Highlight new musical materials.
- Clarify musical communication.
- Demonstrate relationships between objects.
- Steer the audience’s attention.

Table II: Musical opportunities within low-resolution surround systems.

2.0 Layout worries

It is tempting to view 5.1 and 7.1 as limiting due to their set, standardised layouts. Whilst it is without doubt the composers’ choice to adopt whatever system of projection is necessary for the piece concerned, the fixed nature of 5.1 and 7.1 can be considered a compositional opportunity. For this to happen, it is important to remember that having 5 or 7 main speakers does not limit spatial positioning at mixdown to 5 or 7 discrete positions. Any perceived limitation is perhaps a hangover from the lack of image resolution provided by quadraphonic reproduction systems which is further fuelled by inadequate amplitude-only panning methods.

2.1 The centre channel and environment

The main difference offered by 5.1 and 7.1 to conventional surround arrays is that they both support a central loudspeaker, placed equidistant between the left and right outriders. Although necessitated by the dialog needs of the media industry, the centre channel has considerable musical advantages. Frontal images can be stabilised for listeners dispersed around a large listening area (such as in a typical concert situation), and given an added depth. Adding an appropriate amount of centre divergence at mixdown can accomplish this. The key to this process is to feed the centre channel with enough audio level so that its output is not obvious, but just apparent. Again, it is important to not regard the centre channel as a discrete entity unless musically necessary: it is there to assist with the frontal image, and not to necessarily create one.

2.2 Using LFE channel musically

As pointed out by Holman (2001:10), the LFE channel is not a ‘sub-woofer’ channel. The LFE carries low frequency effects: in film applications the LFE would typically carry the impact of a rumbling sound or explosion. Not all music needs the .1 channel, as the remaining channels in the system are full range. Therefore, musical use of this channel may not be necessary, but if it is employed, then it is essential to compose a separate track of musical information for this channel. Simply re-directing the bass from existing channels duplicates bass management procedures in end-user equipment, and does not take advantage of the opportunities the LFE has to offer. In designing sharp, bass transients, punch and
impact can be added as and when required in a way that is musically useful: having an LFE feed from a constant signal source derived from the main channels can often produce excessive, and fatiguing bass.

An alternative use of the 1 channel within uncompressed, non bandwidth-limited environments (such as DVD-A) is to use it to carry height information by modification of the destination loudspeaker layout. Unfortunately, this is not possible on current data-reduced systems such as Dolby Digital ac-3 (Dolby, 2001) and dts (Dts, 2002)

3.0 Portability of musical product

5.1 and 7.1 layout rigs have advantages for composers due to their tightly defined standards (Holman, 2001). Unlike loudspeaker orchestra diffusion methods, master tapes made for 5.1 style sound projection will replay consistently in a wide variety of different venues. Of course, there is nothing to stop composers adding extra tracks to a basic 5.1 layout. In the concert version of Hurricane Ridge (Field, 2002) all 8 channels of the distribution medium are used and tracks 7 and 8 contain a mix which can supplement the 5.1 for live performance situations. The 7.1 format, with its 5 frontal speakers transfers easily to typical loudspeaker orchestra layouts with ease. For example, the BEAST (2002) system of Birmingham University, UK, has a central core of 4 main speakers across the front (“Wides” and “mains”) and 2 speakers across the back. By panning a 7.1 signal so that the centre channel is shared with the front central ‘main’ speakers, 7.1 becomes a very compatible and capable diffusion format for computer music.

4.0 Conclusions

By considering environmental factors, such as the relationship between sound and space, and by adopting consistent approaches towards recording, mixing and projecting surround-sound material, it is possible to deliver sophisticated spatialisation strategies over sound projection systems originally designed to service commercial needs. This paper demonstrates that the challenges in low-resolution systems such as 5.1 and 7.1 are musical and conceptual, rather than being engineering problems in need of solutions.

References

BEAST (2002). Birmingham Electroacoustic Sound Theatre http://www.bham.ac.uk/, last checked, 02/02/2002


