Where are we going?

Is music-only surround sound supposed to be a high fidelity medium, or is it just a pleasant spacial experience? PHILIP NEWELL asks if surround sound is capable of giving us all that we have grown to expect from the best stereophonic reproduction, plus, the sensation of greater envelopment within the music.

TWO-CHANNEL STEREO has achieved a very high degree of sophistication over the 50 or so years of its commercial existence. Within the limitations of different loudspeaker designs producing their own characteristic sounds, good stereo control rooms can produce reliable music mixes whose sounds in other environments are largely predictable. There are things that we know about stereo that can aid the compatibility between control rooms. For example, flush-mounting the loudspeakers in a rigid wall generally leads to a flatter overall response in well-controlled rooms. The room acoustics are also, almost universally, designed with the source and reception ends of the rooms being of a different nature. This could be a relatively dead front half with a diffusive rear half, or a reflective front half with an absorbent rear half, or any number of variations on these themes. Either way, in experienced hands, these rooms can help in the creation of reliable, predictable and musical mixes.

Of course, once the commercial recordings arrive in people's homes, all things are possible. One loudspeaker behind the sofa and one behind the magazine rack are possible domestic placements in homes where musical fidelity is not a prime requirement. Nevertheless, the careful placement of the loudspeakers in a suitably furnished room can usually render a reproduction quality that is largely limited only by the quality of the recording. With this simple, two-loudspeaker arrangement, a piece of music that is well recorded and mixed will tend to reveal itself according to the quality of the system on which it is heard and the suitability of the listening room. That is, it sounds better when reproduced on a better system in a good room.

Over the years, the majority of stereo recordings have been made in a professional way, with the mass market getting whatever they could from recordings and audiophile systems giving superb results. But many surround mixes now seem to be done only to mass market standards, with the audiophiles' enjoyment never entering the thoughts of the mixing personnel because the surround mixes have never been heard on any decent system before reaching the shops. Is the concept of high fidelity now a lost cause?

Some mixers are known to eschew the use of very high quality monitoring loudspeakers, even for stereo, claiming that for their type of music — a summer pop song, perhaps — high fidelity reproduction is not the goal. They are more concerned about how a mix will sound on the radio, or in a bar or a car, because audiophiles are unlikely to buy that sort of music, anyhow. If people wish to take that approach, they are free to do so, and conventional stereo recording set-ups allow this type of flexibility of working practice.

In the case of surround sound, there are two quite distinct approaches to making a mix — two or three-channel stereo plus ambient surround or fully discrete 5-channel mixing. The first approach uses essentially a frontal stereo stage, with the reverberations or certain effects distributed among some or all the loudspeakers. This method is essentially like that of a cinema, where it is considered to be unwise to put any important instrument in the surround channel to avoid 'The exit-sign effect'. This is due to the natural tendency for people to look towards the source of any predominant sound. It is a life-saving reflex in daily life, but in a cinema it only leads to the observation of illuminated signs above the emergency doors. When all the action is taking place on the screen, no cinema director wants the audience to be facing towards the rear of the theatre, hence the restriction of the surround channels to ambient sounds.

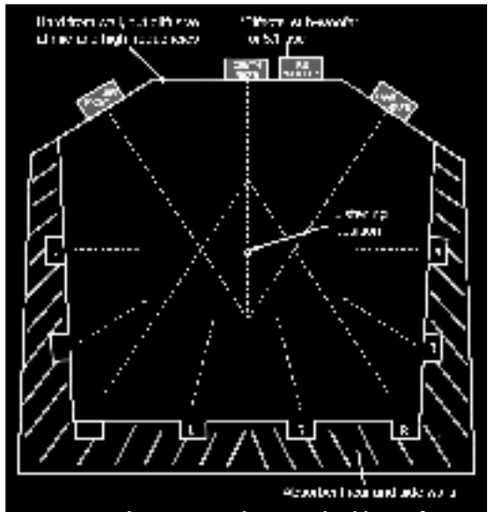

Fig 1. A typical stereo control room with addition of multiple, small loudspeakers for diffuse, ambient surround.

When mixing music in this manner, an arrangement shown in Figure 1 could be perfectly adapted from a very high quality stereo room. Nothing in this control room would in any way compromise the normal stereo capabilities. The only problem with standardising on the use of such a room for surround mixing is that many music producers still want to pursue the idea of fully symmetrical surround monitoring. Many of these producers totally fail to realise the impossibility of the practical realisation of what they are asking for if they are aiming at high fidelity, repeatable results. Yet, despite this, a whole industry has developed trying to supply these needs, even though accurate symmetrical surround monitoring is only truly possible, in an anechoic chamber.

The early attempts at making quadrophonic control rooms failed badly. Many of them merely put two 'front halves' of typical stereo control rooms face to face. The differentiation of the front and rear halves of stereo control rooms had not fully developed in the early 1970s when these early quad rooms were built, so the true repercussions of the problems were at first not fully appreciated. Figure 2 shows a room of 1977 construction, still in use as a recording control room, but in which nobody has even attempted to work on a modern surround mix. Incidentally, the one room in this studio complex (shown in Figure 3) that does work

Fig. 2. Quadrophonic control room of the 1970s showing the two 'front walls' of a stereo room facing each other. Note front speakers are flush-mounted but the rear ones are mounted above the soffits of the machine alcoves — another source of asymmetry.

Fig. 3. Stereo control room adapted for surround in the general manner shown in Fig. 1. The surround loudspeakers are mounted on pedestals at the sides and rear of the room [Eurosonic, Madrid. Control room designed by Sam Toyashima].

in surround is a control room where the monitoring and acoustics closely follow the concept shown in Figure 1. However, it is principally used for mixing music stems for films.

As we have previously discussed, such a room optimises stereo reproduction by the use of different acoustic surfaces for the emission and reception of the sound waves, but in a room where loudspeakers can face in all directions, this concept is not an option. The fact that all of the generally accepted stereo control room designs are asymmetrical from front to back, coupled with the fact that all rooms for symmetrical surround mixing must be symmetrical, creates an obvious conflict. By definition, therefore, a room that is optimised for symmetrical surround monitoring cannot be optimised for the frontal stereo channels. Whether this is a problem or not depends on the importance given to the frontal stereo panorama in a symmetrical surround mix, and also upon whether the room will be used for any other type of mixing, such as two-channel stereo or ambient surround. The two-channel and the ambient surround acoustics would both be compromised by the symmetrical surround requirement. The two approaches to surround mixing are therefore incompatible to the degree that no one room can be optimised for both forms of surround.

In a recent AES Journal paper[1] Slawomir *et al* made a study of the least destructive places to make cuts in the data rate when surround mixes needed to be transmitted by radio over limited bandwidth channels. The outcome of this extensive study led to the conclusion that overall data compression was not desirable. Better subjective quality could be maintained if the front left and right channels were left uncompressed and the centre front and the two rear channels were 'sacrificed' to the relatively high levels of data compression. This strongly places the emphasis on the need to keep front left and right at the highest possible quality levels. If a room has been optimised for the best overall response from all directions, then the quality of the front left and

right channels will inevitably be compromised. There would appear to be no reason why if the sanctity of the front L and R channels is important when dealing with data compression, it should not also be as important in terms of monitoring.

For two-channel stereo reproduction, the flush-mounting of loudspeakers is always desirable so the flattest in-room response can be achieved over a good-sized working area. Unfortunately, with loudspeakers pointing towards each other, they are also pointing towards the solid walls in which the opposing monitors are flush-mounted, as clearly shown in Figure 2. These plane surfaces, which are necessary to flatten the response of the loudspeakers that are mounted in them, are very disturbing to the responses of the loudspeakers that are pointing at them. There is no obvious solution to the problem other than to use large, full-range, free-standing loudspeakers in highly controlled rooms; at least if quality monitoring is required as opposed to simply listening to a pleasant sound. However, this loses the response benefits of flush mounting, and smaller loudspeakers tend to have reduced low frequency responses that usually lead to the use of a subwoofer, or subwoofers, and these can bring their own problems.

If the crossover frequency to a subwoofer is kept below about 80Hz, the general tendency is that the direction from which the low frequencies are arriving will not be obvious. In the case of surround systems, for one person, fixed in a listening position equidistant from each loudspeaker, this could be a good solution, but for any other listeners, or any other listening position, the low frequencies would not arrive synchronously with the higher frequencies. This would give rise to a disjointed transient response and a loss of fidelity, but one reason why this effect is often not noticed is because the transient responses of the majority of subwoofers is so poor that no position can yield an accurate transient response.

Figures 4 and 5 show the response in the time domain of two different subwoofers. Figure 4 shows the response of a typical bandpass subwoofer. The plots show that the low frequencies arrive late, continue to ring long after the drive signal has stopped, and that the ringing is at the natural frequency of the loudspeaker, which may be well away from any musical excitation frequency. The result is time-smeared bass, with a tendency to a 'one-note' boom. This is the audible reality of many surround sound systems — professional and domestic — but it can hardly be construed as high-fidelity bass. Figure 5 shows the response of a horn-loaded subwoofer with overall dimensions nominally similar to those of the bandpass enclosure in Figure 4. This subwoofer does provide a rapid response but lacks sensitivity at low frequencies and thus cannot reproduce reasonable levels without overload.

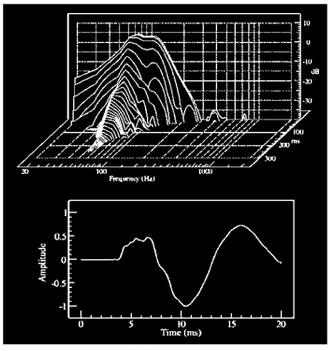

Fig. 4. Waterfall plot and step response of typical bandpass subwoofer in anechoic chamber.

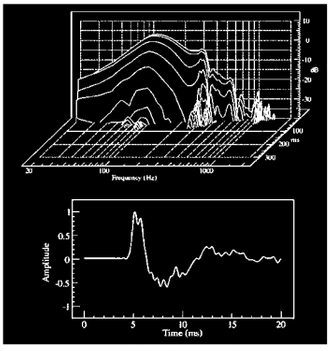

Fig. 5. Waterfall plot and step response of a horn-loaded subwoofer in anechoic chamber.

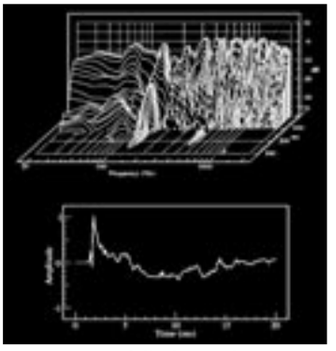

Fig. 6. Waterfall plot and step response of a large, full-range studio monitor system, flush-mounted in the front wall of a well-damped control room.

Figure 6 shows the time response of a good quality, large monitor system, flush-mounted in the front wall of a well-controlled room. Note the speed and relative uniformity of the decay (the extended response at 150Hz was found to be due to a resonant open cable tube). The important point to note is that the in-room decay of this system is much shorter than the anechoic chamber response of the typical subwoofer shown in Figure 4. The use of satellite loudspeakers and compact subwoofer cabinets cannot achieve this sort of synchronised and rapid time response, at least not at the SPLs expected in music control rooms. Compact subwoofers therefore cannot be considered to provide high fidelity reproduction. They merely tend to 'fill out' the bottom end.

Other recent work [2] has shown that unless the crossover frequency to a single subwoofer is kept below 50Hz, it will almost certainly be deemed less involving than stereo full-range bass, and hence again is one step backwards in terms of fidelity.

So where are we going? Time and time again, every step 'forwards' in surround seems to be coupled to a corresponding step backwards in what we conventionally have thought of as reproduction fidelity. And, of course, how many people have the money to buy a system of surround components of equal quality to those that they could afford for two-channel stereo? Two loudspeakers at £500 each or five at £200? Quality or quantity? Accurate transient responses or a muddy boom? Does anybody still care? ■

References

1. Slawomir, K Z, Rumsey, F, Kassier, R, Bech, S, 'Comparison of Basic Audio Quality and Timbral and Spatial Fidelity Changes Caused by Limitation of Bandwidth and by Down-mix Algorithms in 5.1 Surround Audio Systems', Journal of the Audio Engineering Society, Vol. 53, No. 3, pp174-192 (March 2005).

2. Martens, W, Braasch, J, Woszczyk, W, 'Identification and Discrimination of Listener Envelopment Percepts Associated with Multiple Low-Frequency Signals in Multichannel Sound Reproduction', AES 117th Convention, San Francisco, USA, (October 2004).