

RECORDING SURROUND SOUND WITH HEIGHT

MIKE SKEET & JOHN WILLETT

Freelance Location Sound Recordist, Milton Keynes, UK (Mike Skeet)
Circle Sound Services, Oxfordshire, UK (John Willett)

This paper will look into the practicalities of recording surround sound with additional height information.

Based on a standard 5.1 system, but with four additional loudspeakers for height: centre front, centre rear, hard left and hard right in a cross formation.

Various microphone combinations will be shown and discussed, as well as their use in recording sessions.

Also on show will be microphones Mike Skeet has designed for co-incident recording with height and the reasons for the designs will be explained.

HISTORY

Ambisonic recordings were possible in the late 1970s. Four loudspeakers in a square reproduced the Horizontal vector of our 360° spherical world. There were also QS and SQ four-channel systems. There was a UHJ encoding system to “allow” two channels to provide a Surround playback.

The Ambisonic approach was all part of the original Calrec SoundField microphones W, X, Y, Z outputs – providing an Omni (W) and three figure-8s: Front to Back (X), Side to Side (Y) and Up and Down (Z). These are decoded using MS decoding techniques. All three vectors of this 360° spherical world are covered. Eight more loudspeakers, in two more squares of four, were needed to cover the up and down vectors, arranged front and back and to the sides, above and below the listening position.

THE PRESENT

We now have 5.1 Surround, involving DVD-Audio and DVD-Video deliveries. The 0.1 aspect refers to a dedicated LFE (Low Frequency Effects) Sub channel. In 5.0 acoustic recording activities, any Sub loudspeaker would just be associated with the front L & R main loudspeakers.

The ITU standard for 5.0 requires the five loudspeakers to be in a circle around the listening “sweet spot”. The front L and R are intended to be angled at 60° to the

listener. The centre channel in the middle will be at the same distance from the listener. The Ls and Rs (rear surround) are spread out at about 110° in the circle behind the listener. This wider spacing improves the dispersion of ambience around the listener.

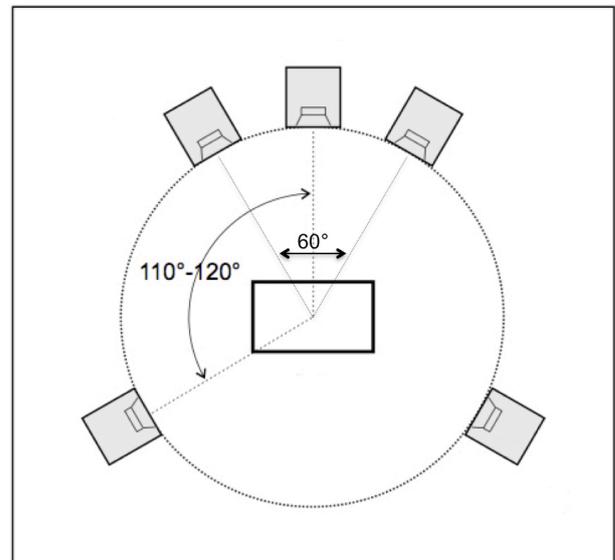


Figure 1 – 5.0 Surround

MORE PLAYBACK REQUIREMENTS

Ideally all the loudspeakers should be away from walls and room corners. All should have matched output levels and be in-phase with each other.

In the case of the system Mike has set-up, he has arranged individual level controls on all feeds, including variable width on the front L & R and for the Ls and Rs feeds.

Tied in with all this is the use of DK Technologies JELLYFISH display and its five level bargraphs. Note, that if you feed in an equal level test tone, the display – “surprise surprise” – produces a full circle!

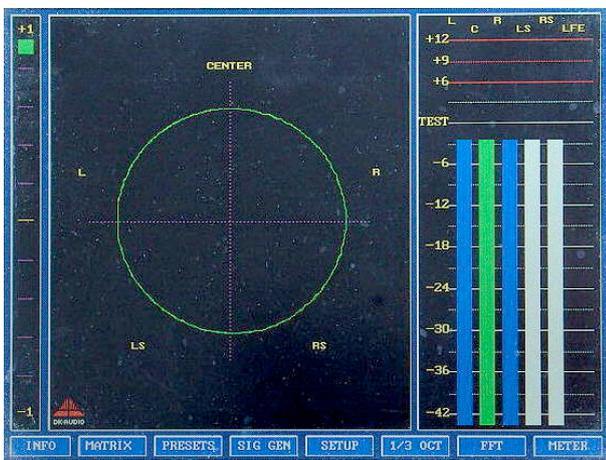


Figure 2 – DK Technologies JELLYFISH display showing a full circle

Any phase relationships between the channels are shown in red on the display and via a Phase meter.

One of the best things is to provide the listener a remote-control facility to go from Mono, to Stereo and then to Surround, and back again and to watch their reaction!

THE MICROPHONES

A basic requirement must be that the “directional” characteristics of the microphones, and any “processing”, must directly relate to the 5.0 loudspeaker layout.

There is also a feeling that, as our hearing system can be judged as being a quite “coincident” detector of the sources of sounds, then the microphone rigs should also be as “practically” coincident as possible, as it’s a set of spaced out loudspeakers that deliver the recorded sources to our near “coincidentally” placed ears.

Microphone Rigs available to inspect

1) The Soundfield microphone is still right at the centre of surround sound, including a “proposed way” of adding Height reproduction to a 5.0 reproduction system; of which more later.



Figure 3 – Soundfield microphone head

The Soundfield’s W, X, Y & Z signals, mentioned earlier, are used to provide the sound distributions required. Appropriately summing the Omni with the Figure-8s produces a collection of Cardioid polar-patterns. These are M&S matrixed for the L & R, the Ls and Rs, with forward Cardioid for the Centre loudspeaker.



Figure 4 – John Willett’s Soundfield SPS200 in a Rycote USM-L mount, with the Soundfield thin and flexible cable tail used for decoupling the microphone from the main cable

2) A Sennheiser collection of three of their MKH range also allows direct M&S matrixing to provide 5.0 Surround and also the Height, to be discussed later. Their MKH 800 TWIN, MKH 30 and MKH 80 microphones are successfully used in this arrangement.



Figure 5 – Sennheiser Rig: MKH 80, MKH 30 and MKH 800 TWIN

3) A Schoeps “Cluster” of five of their small CCM series carries on as above. Four “side-address” CCM4V cardioids cover the 5.0 horizontal requirements, with an upwards-pointing CCM4 providing the Height information, again with M&S matrixing.



Figure 6 – Schoeps cluster of 5 (also showing a 6th (omni) microphone)

4) Pearl DS60, four rectangular capsules allow MS or X/Y use.



Figure 7 – Pearl DS60

5) This is a DPA 4006TL omni along with two Sennheiser MKH 30 figure-8s, which allows a “pseudo” set of W, X and Y signals to be effectively used for the basic horizontal 5.0 surround.



Figure 8 – DPA + two MKH 30

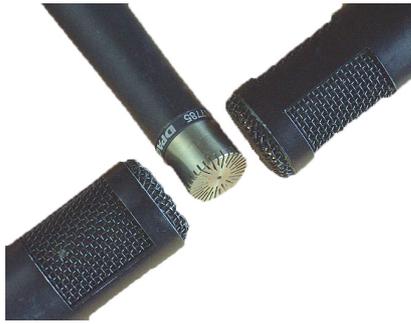


Figure 9 – DPA + two MKH 30 close-up

Non Matrixed Rigs

Omni-directional microphones can successfully be used for direct feeds for the loudspeaker arrays. They are vital for outdoor use as they do not have the handling and wind disturbance that affects directional microphones, particularly figure-8s!

6) Five Schoeps CCM2 omni microphones in an extension of a Dummy Head, for 5.0 Horizontal Surround. There is also a commercial “Holophone” unit available.



Figure 10 – Schoeps “Alien” dummy head created by Mike Skeet

7) DPA 5100. Five Omnis inside a windshield – a “bicycle saddle” looking construction. There is also an LFE output!



Figure 11 – DPA 5100

The L, C and R microphones are very coincident in the middle of the unit and the Interference Tube technique is used to make them directional. The Ls and Rs microphones are spaced out and flush-mounted on the rear of the 5100 unit.

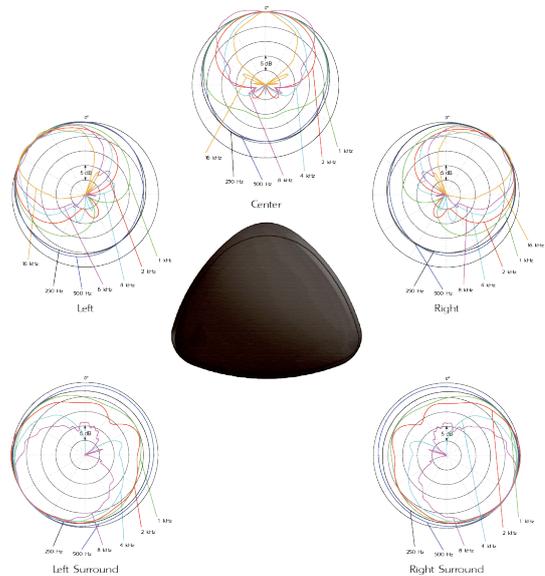


Figure 12 – Diagram showing standard DPA 5100 polar-patterns

Mike has effectively added three extra DPA 4060 omnis on top of the 5100 unit for the Height information. 5+3 equals 8 as only an eight-channel recorder was available.



Figure 13 – DPA 5100 with the “Skeet” modification

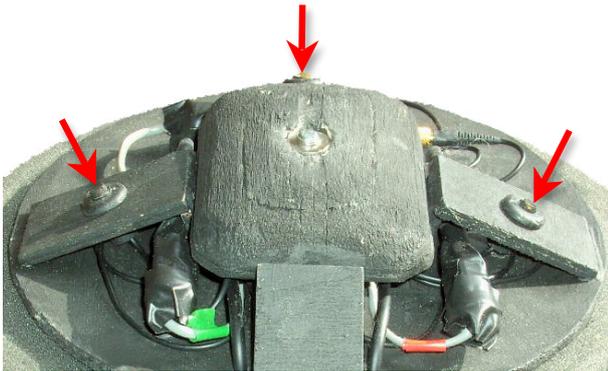


Figure 14 – DPA 5100 with the “Skeet” modification – what’s under the “hat” (the three height capsules are arrowed)

One Last Surround Rig Used

8) Should you have the likes of a Choir, where they just have to be in straight lines, and not in the semi-circle where a single microphone rig can be used centrally, then there is an effective way of stereo capture by the use of two similar M&S pairs, spaced out at one-third intervals, appropriately distant from the straight lines of singers.

You angle each pair inwards to the front centre of the choir and simply M&S matrix each pair in the usual way. What you get is the left output of the left pair covering the left half of the choir and the right output of the right pair covering the right half of the choir. The other outputs simply pick up the venue’s acoustic.



Figure 15 – Choir with two MS rigs (NB: MS rigs points to front centre of the choir)

So, guess what works for 5.0 surround? You feed the other outputs mentioned to the Ls and Rs loudspeakers. The Centre channel is fed with an appropriate summing of each of the Mid microphones in the rigs!

THE PRACTICAL HEIGHT ADDITION TO 5.0 SURROUND

Part of the original Periphony concept is used. Four ceiling placed loudspeakers are used: one pair front to back, and a second pair side to side of the listening position.

The M&S based rigs (1, 2 and 3) mentioned earlier as suitable for the Height facility, easily carry on appropriately with this method for their height feeds.

The three additions to the DPA 5100 unit directly provide the Front Centre Height and the two side-to-side Height feeds, with the horizontal Ls and Rs signals additionally summed together to feed the Rear Height loudspeaker.

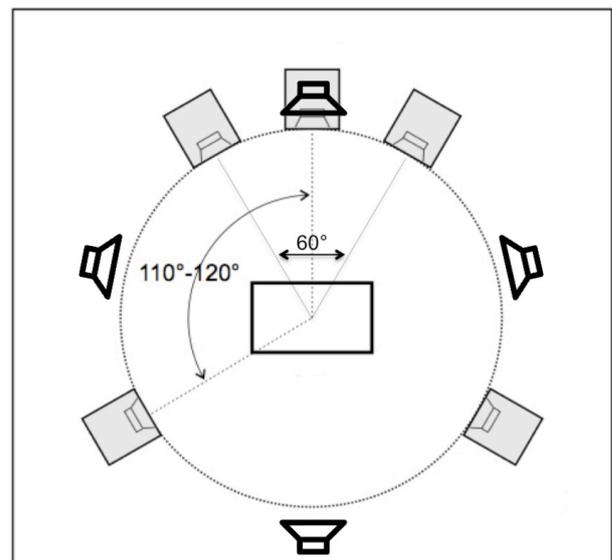


Figure 16 – Diagram showing 5.0 Surround with the extra four loudspeakers for the Height information (these are placed at a height of about 2.5m in our system)

For the useful Visual Monitoring provided by the DK Technologies JELLYFISH display, it is so useful to have the facility to replace the L, R, Ls and Rs feeds with those for the Height loudspeakers. The original Centre feed remains and hence the Display carries on as usual allowing the levels to be checked, with the Centre feed remaining as an important reference.

QED

RESULTS

The important thing in all this, of course, is how it sounds. The height information suddenly makes everything three-dimensional – when switching back to 5.0 surround everything collapses back to a two-dimensional image and feels flat in comparison. In many ways the difference is more astounding than switching between mono and stereo. You get the impression of almost “being there” and are more involved with the music because your ears are getting the separate information that is the acoustic space of the building that you don’t get with a normal stereo or surround system, as it is squashed into the two-dimensional space that those systems reproduce. As the height loudspeakers are only reproducing reverberant information from the venue, you don’t necessarily need large full-range monitors and smaller ones are very practical and don’t intrude on the room.

When I (John) first listened to the set-up in Mike’s listening room I was amazed at the results obtained and how full and involving the results with the additional height information produced. I found myself really not wanting to go back to listening to a normal, flat sounding, 5.0 or stereo system.

ACKNOWLEDGEMENTS

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