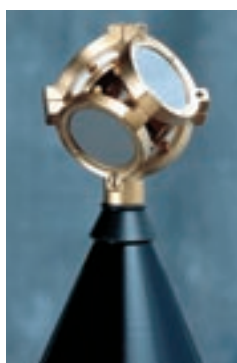


Multichannel mic solutions for OBs

SoundField's B-Format microphone systems have long been capable of capturing audio in mono, stereo, or surround. Now, as HD broadcasters start in earnest to produce audio in 5.1, PIETER SCHILLEBEECKX of SoundField introduces a new digital system that provides a simple and integrated means of creating surround from a single mic.

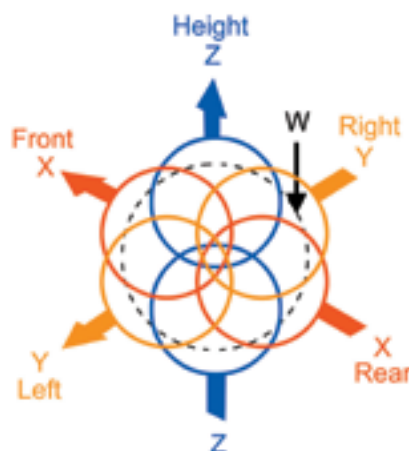


SOUNDFIELD MICROPHONES ARE not new and there has been a mic of that name in existence for decades, well before the SoundField company was founded in 1993. The microphone is based on the principles of Ambisonics, conceived by acoustics and recording pioneer Michael Gerzon in the 1970s as a means of going beyond the stereo and quadraphonic reproduction systems of the day, and including height information in the captured audio signal — a development still not matched by digital surround sound systems today.



From the late 1970s, the SoundField microphone has been capable of capturing a three-dimensional soundfield (hence the name) accurately and repeatedly without recourse to psychoacoustics. It's also been capable of rendering the captured audio as a listenable stereo or mono signal without any of the audible phase-related problems that frequently bedevil attempts to render three-dimensional sound recordings suitable for reproduction on conventional hifi systems. The SoundField has made a name for itself, especially among classical recordings engineers, as an accurate microphone capable of producing recordings of great clarity in stereo and in multichannel surround. This impressive imaging is due to the phase response accuracy of the SoundField microphone. However, there have always been more affordable ways of recording in stereo, and for many years the SoundField mic's appeal was limited by the lack of widespread commercially available systems that could reproduce its three-dimensional audio output without first folding it down to stereo or mono.

All this has changed with 5.1. As TV companies



The four signals that make up the SoundField B-Format, with the three fig-8 responses X, Y and Z at right angles to one another, and the omnidirectional reference W.

gear up for the move to High Definition (HD) broadcasting, for which 5.1 is required, the number of broadcasters who require a quick and easy method of recording in 5.1 while maintaining perfect mono and stereo compatibility is increasing fast. SoundField microphone systems can produce high-quality mono, stereo, mid & side and surround sound recordings in a variety of formats, all from a single mic, and simultaneously if required. This is useful to broadcasters who need to navigate the transition from stereo to multichannel audio carefully over the next few years if they're not leave their viewers behind.

Although the simultaneous output of all these audio formats has been possible with SoundField systems for many years, the company's designers have spent five years refining and improving its technology to produce a single-mic surround-ready system for HD broadcasters. This new microphone system, which is also the first SoundField to carry out all its processing

and audio format decoding in the digital domain, is called the DSF-2.

For the above reasons, SoundField products are becoming something of a standard choice for capturing surround at large-scale events that are broadcast live in 5.1 and stereo. Examples include high-profile sports fixtures like UK Premiership football matches and the Ryder Cup golf championships for Sky Sports, as well as challenging musical OB events such as BBC Scotland's coverage of Glasgow's international bagpipes competition, the World Pipe Bands Championship. This year, OB truck companies like Visions, CTV, Arqiva, and Observe in Eire have equipped their HD OB vehicles with SoundField systems.

SoundField systems employ a patented multicapsule microphone, in which four sub-cardioid capsules are mounted in a tetrahedral array, and one of several hardware processors. The 4-channel signal produced is a proprietary form of output known as SoundField B-Format, and its four constituent signals are known respectively as W, X, Y and Z. The last three represent the soundfield around the microphone in three dimensions — as though it were recorded by three fig-8 mics placed at right angles to one another — while W constitutes an overall reference signal as though recorded by an omnidirectional capsule.

The initial processing also corrects for the fact that the four signals have been recorded at a slight physical offset from one another because it is impossible to mount the capsules at exactly the same physical point in space. However, because the distance of the four capsules from the centre of the tetrahedral array is small, known and constant, it is possible to process the output of each capsule to generate four signals that correspond to those that would be created by recording at exactly the same point at the centre of the array. This eliminates phase problems between the four constituent channels of the B-Format signal, and is central to the SoundField concept. It allows the four phase-coherent channels to be combined without any unpleasant-sounding phase artefacts, the usual drawback of multimicrophone or other multicapsule systems.

By combining the four signals making up the B-Format in different proportions, it is possible to generate an audio output in any format from mono to surround, including any future three-dimensional formats that are yet to be defined. Simultaneous decoding from B-Format to several different audio formats is also possible. If the 4-channel B-Format signal is recorded the output format can be determined at a much later date by running it through the B-Format processor. This makes the B-Format an excellent archive format.

The process of combining the four phase-coherent B-Format channels in different proportions can be controlled from switches and knobs on SoundField's software and hardware B-Format processors, and allows users to change the mic's pickup pattern continuously from omni through cardioid to fig-8. The virtual orientation of the mic — the direction it appears to face — can also be continuously controlled from the processor. This is useful in OB situations,

where the mic often cannot be physically accessed or adjusted once broadcasting has begun. Such 'audio zooming' and 'virtual rotation' of the mic can also be carried out by postprocessing a stored 4-channel B-Format signal with a SoundField hardware processor or software plug-in.

This flexibility and format independence has been popular among HD broadcasters of late and the DSF-2 was designed specifically to appeal to the broadcast market, through listening to input from Sky Sports and HBS (Host Broadcasting Services, the company created to transmit the FIFA Soccer World Cup). Specifically, this resulted in the use of 75ohm AES3-id unbalanced coaxial cable to connect the DSF-2 decoder to its broadcast vehicle, rather than a standard 110ohm balanced XLR. This allows the reliable transmission of the audio data over far longer cable lengths — depending on the exact coaxial cable used, the decoder can be up to 1000m from the broadcast truck. Moreover, the cable supplied with the DSF-2 to connect the microphone head to the decoder can be a further 300m long, allowing the mic to be placed reliably at total distances of up to 1.3km from its OB truck. This flexibility is popular with OB companies, who often can't position their trucks close to venues. Another feature requested by broadcasters was the presence of a simple analogue stereo output on the DSF-2 decoder itself. This can be used to generate the ambient element of a headphone monitor mix for commentators at an event, for example.

Although the concepts of the B-Format, the tetrahedral multicapsule array and its phase-coherent signals remain at the heart of how the DSF-2 works, it represents a modern implementation of the original theory and as such produces an even better sense of localisation, phase accuracy, and high-frequency sonic detail.

SoundField has completely overhauled the analogue electronics in the DSF-2 microphone; a low-noise, low-distortion JFET signal path is now in place throughout. Relay-switched, low-tolerance gain components are also used for the 4-channel mic preamp, rather than multigang pots or VCAs that would have resulted in higher distortion and noise figures. Newly devised capsule-matching methods at the manufacturing stage add to this, ensuring that channel matching, a vital part of the B-Format concept, is even better in the DSF-2

than in previous SoundField mics. Detailed study into the interaction between capsules and the microphone bodywork has resulted in more constant polar patterns from one capsule to the next. And the capsule array itself has been improved, the physical spacing between the four capsules having been further reduced (while maintaining the capsule diameters for reasons of audio quality) so that less correction is required to produce the ideal single-point coincident signals.

The mic now uses discrete low-noise voltage regulators for its bi-polar rails and the polarising voltage, and incorporates balanced line drivers on its outputs capable of driving 600ohm loads — hence the ability to use longer cable runs. The mic has better input tolerances all round. There's a new JFET limiter at a fixed threshold of 3dBFS, which is designed to work on all four input signals equally to maintain spatial aspects

when it's active, and the inputs have an extra 6dB of analogue headroom once 0dBFS has been reached.

As mentioned earlier the DSF-2 is the first SoundField product to use digital signal processing and employs an Analog Devices SHARC for improved accuracy, channel matching and repeatability.

However, in practice it is the DSF-2's ease of use as a simultaneous 5.1 and stereo-compatible mic (over long distances) that is making it a success among broadcasters. In mid-2006, The Host Broadcast Services installed DSF-2 mics at all 12 German stadia involved in the FIFA World Cup and used them to broadcast ambience in stereo (for SD and radio signals) and 5.1 (for the televised HD transmissions) simultaneously to an audience of some 40 billion. Having had an influence on the development of the mic, Sky Sports has permanently installed the microphone at several major UK football grounds to

provide 5.1 crowd and venue ambience for its HD coverage of UK soccer premiership matches. Sky recently specified the DSF-2 for use on all of its HD sports coverage.

Michael Gerzon's inventions were ahead of his time. Over-specified for stereo recording at its invention the SoundField microphone is only now, three decades on, truly coming into its own at the vanguard of surround. And the 21st-century improvements made to the hardware during the creation of the DSF-2 are designed to safeguard the viability of the SoundField/B-Format concept for many years to come. ■

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The Rotate controls on the DSF-2 decoder allow the mic to be 'turned' without physically altering its position, by altering the balance of the B-Format signals with respect to one another.

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