◀ *Here the tetrahedral microphone array used for ambisonic recording is used to capture the direct and reverberant sound field in St. Giles' Church, in the city of London.*

Worldwide, interest is growing in this effective new way to obtain true 'surround sound'. Andrew Pozniak describes the latest developments.

AMBISONICS

In recent issues, contributors such as Dr. Farrimond and Prof. Fellgett have generally questioned what four-channel is all about and what its actual goals are. With this interest from both academic as well as commercial institutions some exciting developments are coming to light with the promise of more to come.

In this article a broad look is taken at the "Kernel" approach to "Surround-sound". Since these innovations are yet in their embryonic stages, little in the way of information other than of an academic or peripheral nature is available. Also patents already applied for, preclude much practical technical data being published.

As more information comes to light further articles will be published. A broad list of references is listed at the end of this article. To indicate how current this topic is, the last reference is to a paper given by M.A. Gerzon "Psychoacoustic criteria relative to the conception of matrix and discrete systems in tetraphonics". This was read at the International Festival of Sound in Paris earlier this year.

It is not without some renewed eagerness and anticipation that further developments from various sources are to be looked forward to, after the somewhat meandering start that quadraphonics has had.

"QUADRAPHONICS" has been with us for some time now, but, unlike the introduction of stereo about two decades ago, its acceptance by the public is far from accomplished.

The major reason for this is that in spite of much work by manufacturers on developing a viable system for this new dimension, none of these systems comes up with a "convincing" argument or sound in keeping with what is the basic purpose of the whole exercise.

A polyglot of systems has evolved (SQ,QS,RM,CD4,UMX etc.) all have a sound technological approach, however arguments for and against each method have been raging since their inception, especially by their innovators, each wishing to see their system adopted as the standard.

Unfortunately out of this "Babel" little has resulted except confused consumers, slow sales of already manufactured four-channel equipment and suitable records, and perhaps most important, non-emergence of any sort of standard throughout the industry.

Most vivid proof of this state of affairs is the growing number of positions one sees on the "mode" switch of currently manufactured four-channel amplifiers with inbuilt multiple decoders to cover every possible contingency.

A slight polarisation of thought in favour of the CD4 discrete system is in evidence, especially in the USA. However before even the adoption of *that* system takes place severe re-thinking of the whole approach is definitely merited. This last statement is prompted in the light of recent technical papers on the subject as well as experimental work being done both at academic institutions and by certain companies in various countries.

P. B. Fellgett, Professor of Cybernetics and Instrument Physics at

Reading University has teamed up with John Wright and, under the co-sponsorship of the National Research Development Council of Great Britain and the IMF company has been conducting research into a new concept for multi-channel sound recording and reproduction called "ambisonics".

As a result in 1971 a patent was taken out by NRDC arising from developments carried out at Reading University. At present experiments are mostly being carried out by IMF under Prof. Fellgett, John Wright and a more recent member of the team, Michael Gerzon, an Oxford University mathematician. Considerable help has been forthcoming from many parts of the audio industry from such companies as Dolby Laboratories and Calrec.

The first major public demonstration of Ambisonic sound was given at the recent Sonex '74 exhibition in London.

Unfortunately the demonstrators could hardly have picked a worse spot than the room they had allocated to them.

The acoustics of the room were completely unsuitable for the demonstration. In spite of the handicap one or two selections did give an idea of what an ambisonic system is capable. One particular piece of organ music produced a strong impression of the sound echoing inside a church. Some aspects of what "ambisonic" sound is, did come to light.

Professor Fellgett hopes to arrange a future demonstration in a more suitable location.

The new technique improves on present quadraphonic systems because of its ability to present natural sound images between front and rear pairs of speakers, and to reproduce sounds which seem to arise either between listener and loudspeaker or beyond.

So much so, that Mr. Gerzon believes that "Quadraphonics" as conceived widely at present, is a Dead End.

Unlike conventional quadraphonic approach, the new "ambisonic" system uses information from a multidirectional microphone array encoded onto just two channels. This means that the complexities of surround sound techniques are relegated to the recording studio and not the living room. It is envisaged that apart from two separate loudspeakers suitably in phase only a decoder will be necessary to convert an existing stereo system.

This new approach is not to be confused with the so-called matrix systems to date. In matrixing, information from conventional microphones is artificially blended to achieve synthetically the approximation of surround sound.

With ambisonics sound from every direction is picked up by a tetrahedral microphone array and is treated equally until the decoding operation.

In retrospect there have been two approaches to surround sound four-channel reproduction.

1. "Matrix" systems which aim to simulate discrete systems via less than four channels.
2. "Discrete" systems, which use four channels to create phantom inter-speaker images by feeding (panning) sounds only to the two adjacent speakers.

Now, with "Ambisonics" a new approach is emerging. This uses the "harmonic synthesis" or "Kernel" system. This new approach requires some explanation. The aim of a Kernel system is to convey through a finite number of channels an infinite number of directions (and thus an infinite number of channels). The mathematics used is not "Matrix" algebra but what is known as "Kernel" algebra (which is the corresponding mathematics used when one has an infinite continuum of variables).

"Kernel" systems start from the observation that the desirable effect is to produce a sound coming from an infinite number of directions around the listener. Such systems imagine a limited number of channels (two, three or four) being used to convey the sound to the listener, but are designed to create a continuous range of directions around the listener thus approximating the original. This re-creation may take place via (say) only four speakers. The signals fed to the speakers do not matter in themselves, only the directional effect of the sound field at the listener matters. (This philosophy is close to that expressed in Blumlein's famous 1931 stereo patent.)

Commercial examples of Kernel systems are the UMX family of systems of Nippon-Columbia, Japanese RM systems excluding Sansui's QS system which is only an approximation to RM., and also the British NRDC "ambisonic" system.

Work along similar lines is being done in Germany by Sennheiser.

All in all, it would appear that at long last some more rationalised approach, as to what four channel surround sound should really be, is being taken. Interestingly enough the impetus for this has come from the academics rather than commercial incentives.

Pop-gimmickry and special-effect records may offer the recording-engineer scope for juggling the controls. However, it is high time that the record makers realise that in general the serious listener likes music "au naturel" – as close as possible to the original. If this goal can be achieved by quadraphonics then let it be so; but unadulterated by synthetic (stereo or four channel) "pseudophonics".

It is obvious that the whole question of quadraphonics is in a state of ferment and movements in the right direction are being made. This year should see many interesting developments and further articles dealing with the topic will follow as information comes to hand.

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