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STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

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INTRODUCTION

Broadcasters in the UK are preparing to meet the challenge of realising Blumleins' 1933 ideas for Improvements in and relating to Sound Transmissions, Sound Recording and Sound Reproducing Systems, and to quote:-

"For the case in which the sound is associated with picture effects improving the illusion that the sound is coming and is only coming from the artist or other sound source presented to the eye."

Note the words 'improving the illusion'.

Four decades of focussing our eyes down a narrow viewing angle towards a postage stamp television picture has created the illusion that the sound is coming from the artist or other sound sources presented to the eye when, in actual fact, it usually emanates from an inferior five inch loudspeaker on the side of the receiver.

If only we could get loudspeakers to function from inside the cathode ray tube and emulate the cinema industry's loudspeakers mounted behind the transparent screen.

Way back in 1880 Graham Bell referred to the stereophonic phenomena of binaural audition, when describing experiments on the directional sense of hearing, and Stereophonic Sound it is today.

In the year that BBC Radio, the APRS and the IBC celebrate their 21st Birthdays, many countries and the BBC can claim to be transmitting television programmes with stereophonic sound, and the AES has published a 386 page Anthology on Stereophonic Techniques. What could anyone say on the subject of Stereophonic Sound that has not been written or said before?

The development of High Definition Television is inevitable on account of the forces working in the scientific world today and there is no doubt that it will be accompanied by four or five loudspeakers, so why not join the brigade of sceptics who say the substantial effort and capital cost is not worthwhile to attempt to provide this illusion with a postage stamp picture?

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Indeed, are we really going to take twice as long in audio post production and will the receiver manufacturer double up his inferior five inch loudspeaker and provide the Viewer with some form of do-it-yourself stereo control that will obviously compete with the broadcaster's transmissions?

SUBJECTIVITY

History points to the fact that the control and monitoring of Stereophonic Sound with television pictures is not only full of uncertainty, but is also wrapped up into one enormous bundle of subjectivity. Think of any subject associated with Audio and it seems to find a place on the list, as well as having to be digital.

For many decades, it has been accepted that different types of microphones produce different qualities of sound, no two control rooms seem to have the same dimensions and acoustic response. There will always be a better loudspeaker than the one selected to be the standard and we must include sound levels, meters and flux levels. To complete this great big beautiful bundle of subjectivity, there is of course the brain of the Sound Controller.

With so many variables in series one is tempted to say that Stereophonic Sound is an illusion, forget it!

On the other hand, with the right microphone on the studio floor or in the field, we can create an illusion of stereophonic sound and, at the very least, we could replace the point source that exists at the side of the tube by two strategically placed loudspeakers.

If the sound controller concentrates on panning speech centrally and spreading the music and effects throughout the soundfield, I believe the majority of viewers can look forward to a significant enhancement of intelligibility and spaciousness.

However, certain areas of the sound production process become more critical with stereo and it is these that I would like to consider.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

The creation of the Soundfield

Soundfields come in many different shapes, sizes and forms. The Cinema Industry, who have produced well over one thousand feature films using Dolby Surround Sound, are well ahead of Television in creating Soundfields and there is no way that a two loudspeaker system can compete with a Left, Centre, Right and Surround Loudspeaker system.

Nevertheless, every cinema produces its own unique quality of sound reproduction, as does every concert hall. All have their own characteristic soundfields which are acceptable but different.

The Cinema/Dubbing Theatre

In the late fifties, it became apparent that the intended stereophonic effects of the dubbing mixer were not being perceived by the majority of cinema audiences. To overcome this, they introduced a dedicated centre loudspeaker behind the screen and dubbing theatres took on very large dimensions so that the dubbing mixer could appreciate how his balance and control would be reproduced in the cinema.

The Theatre

In the Theatre, we frequently see public address sound operators sitting in the audience controlling the sources on stage. This is the ideal one-to-one situation, where sound controller and listener are in the same room.

Unfortunately, a one-to-one relationship between a Television Control Room and the Living Room for Stereophonic Sound would seem to be an impossibility.

The Living Room

Listening conditions will vary widely between living rooms and every viewer will hear a sound that is unique to their own environment.

It would seem to be sensible for Sound Controllers to carry out spot checks using mini low fidelity loudspeakers and even to listen to their work when it is transmitted to their own living rooms.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

The Control Room

Whilst the dimensions of the average broadcaster's control room and the average living room are not far removed from each other, the difference between a room full of metallic equipment and one full of soft furnishings is as different as chalk from cheese.

Text books on acoustics inform us that the geometric and acoustic properties of control rooms and listening rooms can considerably influence the perceived quality of sound especially in stereophony, and that this influence may cause studio operators to impair the quality of output without realising that they have done so. I shall return to this important problem later.

It appears that the conflicts between the acoustic and operational requirements for control rooms have not been optimally resolved.

Operationally, it is essential that the Sound Controller has an eyeline to the Director in an adjacent control room and that he has ear to ear agreement with the Producer in the Sound Control Room. We must pay attention to the sound control room acoustics to ensure that faithful illusions are experienced by the sound controller and the Producer, and that they are repeatable from one control room to another.

Loudspeakers

The control and monitoring of stereophonic sound entails a continuous succession of subjective decisions when listening on Standard Monitoring Loudspeakers.

Further, as we must monitor Mono compatibiliy, it is essential to carry out frequent A-B listening tests on the stereophonic phantom or centre image and the Mono sum of the left and right signals.

To meet this requirement there must be a loudspeaker placed as close as possible above or below the centre of the transmitted picture and a mini low fidelity standard loudspeaker will be acceptable for this purpose.

Each Broadcasting Organisation has its own criteria for choosing loudspeakers which are acceptable for technical quality assessments and it is generally agreed that the quality of the loudspeakers, and their position in the room, is probably the most important source of difference in perceived quality.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Loudspeakers continued...
With the birth of a new monitoring loudspeaker every week, and a few more decades ahead of us before the perfect loudspeaker is produced, it becomes desirable to seek some form of standardisation for controlling the acoustic response of control rooms and to recognise the importance of loudspeaker monitoring level.

Listening Level and Dynamic Range
The importance of the loudspeaker listening level for reproduction of sound is well recognised in the Cinema Industry with the recommendation for a playback level of 85db-C per channel for 50% modulation and their experience has shown that it is the monitoring level which affects mono compatibility to the greatest extent.

The average sound pressure level in the home is some four to six db's lower than the standard level in the Cinema and will certainly be many db's lower than that heard in the majority of production control rooms.

The lower listening level in the living room requires a narrower dynamic range to be acceptable and for the normal spoken word this amounts to a range of no more than 12db's.

Production Techniques
If we accept the fundamental objective of stereophonic sound in television is to create the illusion that sound is coming from the artists, or other sources presented to the eye, and we wish to introduce a sense of 'occasion' or 'spaciousness', then we must look firstly at production techniques in the studio and on location.

Practical requirements dictate that with a compatible system we must not degrade the monophonic signal. Also, we must have control over the width of the soundfield.

Blumlein conceived stereo not just as left and right but also in terms of a Sum and Difference signal. He also devised the M & S mike technique.

This appears to be a very powerful production tool since, by proper choice of polar pattern, a high standard of monaural quality can be maintained.

Listening to the M signal during microphone placement simplifies monaural compatibility, whilst processing signals in M & S format enables simple control over the width of the soundfield before matrixing to left and right for transmission.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Production Techniques continued...
The Sound Controller will soon learn about Shuffling, which is the name given to the technique of applying different degrees of equalisation to the Sum and Difference signals, and should the Sound Controller direct all sources of sound into poorly designed limiters and compressors, and be a poor shuffler of equalisation controls, we could hear some most unusual illusions.

The M & S technique allows the boom operator to continue normally and the Sound Controller has full control and the flexibility that he needs in Post Production.

The Post Production Control Room
Whilst some productions in the studio may well be balanced and recorded in stereo, the majority of programmes, especially those on location shot on different days, will be assembled in the post production control room.

So what problems can we expect with stereo dubbing? Well, after a sound controller has rocked and rolled over the video edit joins a few times he will become thoroughly familiar with the dialogue track. Adding music and effects in stereo may well then be recorded at too high a level.

It is therefore absolutely necessary to check the derived left plus right mono signal on a centre speaker for intelligibility of dialogue and that mono compatibility is acceptable.

I have indicated how we can control and produce the stereo illusion up to the monitoring loudspeakers but, without the generated sound pressure levels being reproduced faithfully in the sound controller's 'Golden Ears', it is still possible to get it wrong.

Here the control room acoustics come into play and if the acoustics are not carefully controlled, our illusion can still be destroyed.

Acoustics
Venturing into the black art of acoustics we find that every control room superimposes its own unique acoustic signature tune onto the programme sound emanating from the loudspeakers and the degree to which this so-called science influences the control of sound quality may be pleasant or unpleasant.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Acoustics continued...
Suppose that we have a workable monitoring environment but one that has shortcomings in low frequency reverberation time and left right loudspeaker balance; and that Time Delay Spectrometry measurements reveal that there are very strong reflections below 200Hz, that will inevitably not only influence the perceived sound in the listening area, but will also affect image placement.

The Sound Controller will set to work on the equalisation controls until the sound quality meets with his approval and he may be oblivious to the fact that he has produced an over processed signal with a heavy bass response, excessive reverberation time and inconsistent image placement.

Time Delay Spectrometry
In 1967, an important chapter in the history of audio measurements began when Richard Heyser presented his work on Acoustical Measurements by Time Delay Spectrometry and twenty years later, instrumentation is in the hands of acousticians that helps us to understand many problems.

The parameters Amplitude, Energy, Time and Frequency are tools for Acousticians and Sound Controllers. It is just a question of how these tools are used.

Multiple acoustic images, whether originating from prime programme material in a public address situation, or in a control room from early reflections, generally speaking introduce some impairments to the sound quality, possibly intelligibility and image placement.

Knowing that the Amplitude and the quality of the early reflections can create problems, there is a flicker of hope that one day we may be able to define and measure the listening area around the mixing console.

There are a few important criteria which, if satisfied, will ensure a minimum standard performance, for instance, all text books will agree on acoustic symmetry forward of the listening area, and the ratio of direct to reflected energy should not change significantly within the defined listening area.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Time Delay Spectrometry continued...
Also, the development and subsequent decay of energy within the room must be controlled in such a way as to minimise colourations of the direct energy spectrum. In other words, it is the problem of the room superimposing its own unique signature tune onto the programme sound.

Those clever at mathematics can easily prove that a measurement of the impulse response is equivalent to a measurement of the frequency response and vice-versa and that the complex frequency response of a system can be measured by many different methods. Time Delay Spectrometry, or the process of spectral analysis with the ability to analyse and discriminate signals that are delayed relative to the stimulus, is one such method.

Measurements of energy over the frequency bandwidth enable acousticians to discriminate between direct, early and reverberant soundfields, and to judge whether the summing of the left and right loudspeaker is satisfactory in the listening area.

It is also possible to identify individual reflections and make comparisons between the left and right loudspeakers.

The coincidence of high amplitude, early reflections has considerble effect on the stability and localisation of the stereo image and, if this is not bad enough, the effect of room boundaries can result in either cancellations or reinforcements of the energy spectrum as perceived by the listener.

An added complication is that because of the Haas Effect, no two people in the control room will perceive the same stereo image.

Researchers, notably Haas, have given us a well accepted theory that explains how we perceive multiple positioned sources. We tend to localise a sound at the position from which the first arriving sound originates.

As only one person can sit in the driving seat to control the phantom image, and as there can never be a one-to-one relationship between him and a Producer when it comes to any discussions that involve image placement, fastidious attention to sound image positioning to complement a postage stamp picture becomes meaningless.

Maybe in the future, Producers will preview their creativity in a standard living room.

STEREOPHONIC SOUND - WILL IT WORK FOR TELEVISION?

Meters

Over a period of many decades broadcasters have evolved procedures for using VU meters and PPM's to control programme levels, and these procedures will continue to be satisfactory to the organisations using them. However, the requirement for two audio signals travelling two separate paths gives rise to the possibility that there will be errors in both Amplitude and Phase between the two paths and, as it is vital to maintain a good stable phantom centre image, and to prevent transients finding their way into the pre-emphasis networks associated with digital black boxes, it becomes essential to look for a new instrument that will measure peaks and phase accurately, this could take the form of an Audio Vectorscope that has no ballistics, is not sensitive to frequency and waveform and can display logarithmically the vector sum of instantaneous voltage levels. In other words, it is roughly similar to an oscilloscope operating in X - Y mode.

The well equipped control room should have an Audio Vectorscope that immediately informs the Sound Controller of what is going on in the Soundfield in the way of:-

Stereo Width - Source Locations
Stereo Balance - Mono Compatibility
System Overloads - Phase Shifts - Phase Reversals -

and finally, we must not forget, accurate line up levels.

A tall order but not an impossible one.

TRANSMISSION

By the end of 1990 it is anticipated that the major transmitting stations in the UK will be equipped to transmit Dual Channel Sound to 75% of the UK population.

Television Pictures with Stereophonic Sound will find their way into a Dual Channel Sound in Syncs System which will send a digital bit stream to the transmitting station.

From this time forward, Sound Controllers wil cease to concern themselves with lack of bandwidth and noise and endeavour to learn that the performance of Dual Channel Sound signals is judged by the audible impairments caused by bit errors.

This is a significant improvement in the transmission chain to the viewer.

CONCLUSION

With the right microphone on the studio floor and in the field we can create the illusion of stereophonic sound.

We must however bear in mind the importance of the one-to-one relationship between the Sound Controller and the Viewer which, if we are not careful, can be destroyed by poor sound balance and not enough attention being paid to control room acoustics.

At the very least, if we replace the point source at the side of the tube by two strategically placed loudspeakers, concentrate on panning speech centrally, and spread the music and effects throughout the soundfield, the majority of viewers can look forward to a significant enhancement of intelligibility and spaciousness in that they will hear subtle details of quiet sounds in the presence of loud sounds. Only when we have large television screen displays in our homes can we begin to emulate the excellent results obtained with current cinema presentation, and four or five loudspeakers with a five by three picture is yet another illusion.

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