

THEATER STEREO FOR THE HOME

Richard M. Wolfe

Twentieth Century-Fox Telecommunications

Stereo simulcasts for certain television programs via FM radio, both direct and over cable, have been done for many years. Video cassettes and video discs now provide an additional source of stereo sound for television in the home. Up to now, such stereo has been two channels (left and right) only. Thirty-five millimeter motion picture stereo is presently four-channel stereo. Today a technique exists to transmit four channel theatrical stereo into the home via any cable, FM broadcast, or home video delivery system. By use of a special Dolby Stereo decoder, the four channels can then be recovered which provides audio quality and realism equal to or better than that obtainable in the typical motion picture theater of today. With a large screen TV this system can truly convert television viewing into the stereo theater of the home.

In 1953, 20th Century-Fox released the first motion picture in Cinemascope with stereophonic sound. This sound was recorded using four separate magnetic soundtracks and released on prints which were equipped with four magnetic stripes running along the film located inside and outside the film sprocket holes. These four tracks were recorded with sound designed to be played back over three large speaker systems behind the screen, and a group of smaller speakers located in the rear of the theater. The three screen speakers were arranged with one in the center, one on the left, and one on the right. In this way, the location of the sound source could be made to match the location of the picture action across the screen face using sound from three of the tracks. The fourth track contained a rear "surround" channel designed to be played back over a "curtain" of speakers all connected together and placed around the rear and side walls of the theater. This surround channel was used to provide ambiance, or reverberation for music, and

for many special off-screen effects such as thunder, rain, airplanes, explosions, and the like.

This theatrical stereo technique became quite successful and was used for a number of major films in the years following THE ROBE. There were problems however. The magnetic striping and real time recording on release prints was expensive, and playback headware and system alignment in the various theaters around the world required frequent attention and maintenance. Many theaters complained about these problems and in the early 1970's Dolby Laboratories, whose name today is well known for the development of audio noise reduction systems, began the development of a new theatrical stereo process to try to solve these problems. The Dolby stereo development incorporated two major concept changes as compared to the discreet four-track magnetic system. The first was the use of a stereo matrix process. This matrix technique involves combining the four left, center, right, and surround signals into a two-channel encoded signal, which then contains all of the information present in the original four signals, but requires only two recording channels rather than four. The second was the development of a two-channel optical recording device so that two high quality optical soundtracks could be placed on the release prints in the space previously occupied by the single monaural optical track, in use since the beginning of motion picture sound. This improvement meant that this two-channel optical track could be printed onto release prints during normal laboratory picture printing and developed as part of the picture processing and development, a process revision that eliminated the cost of magnetic striping and recording each print.

Theaters were then equipped with compatible two-channel optical playback readers which could read both traditional mono tracks and the new Dolby stereo optical twin tracks interchangeably. In addition

to the two-channel optical reader, the projection rooms were also equipped with a matrix decoder to unscramble the two-track audio signal back into the original four discrete signals: left, center, right, and rear surround.

The Dolby theatrical matrix system is analogous to the CBS/Sony SQ or Sansui QS "Quad" systems for home stereo of some years ago, but the Dolby encoding/decoding system is somewhat less complex. With Quad, two channels are used in front and two channels are placed in the rear of the listening environment. This gives a listener the ability to hear an apparent sound source in a 360 degree horizontal location around the listener. The Dolby technique relocates the channels, with three channels in front, in the plane of the visual action, and one channel in the rear. This speaker placement concentrates the sound in the picture area while still allowing some source of sound from the rear. The Dolby speaker locations do not allow specific localization of sounds at various points across the rear or along the theater side walls, but is intended to give the primary sound focus across the screen. Dialogue, however, is placed only in the front center channel. This helps to minimize crosstalk with the rear, where dialogue is undesired. A time delay circuit is also incorporated in the rear channel to further minimize crosstalk in the rear channel. The rear signal is delayed so that any front channel signal will arrive at a viewer's ears at least 30 milliseconds before a signal from the rear. The Haas effect then insures that rear channel crosstalk will be undiscernible.

The Dolby theatrical stereo system also makes use of the noise reduction systems for which the company is best known. The two encoded channels are recorded with the professional A type system on the optical track giving a signal to noise ratio of about 60 db and optical galvanometer improvements provide a flat frequency response from about 20 Hz to beyond 15 kHz. This is a great improvement over traditional mono optical soundtracks which are limited to about 8 kHz in 35mm and about 5 kHz in 16mm. In order to further minimize unwanted noise from the rear surround channel speakers, which are often quite close to the ears of viewers located in the rear of the theater, and which frequently have "no signal" conditions, the additional use of a modified form of the home B type noise reduction is used as well to further suppress the noise in this channel.

To date, over 400 titles have been released using the 35mm Dolby stereo process and many have also been released in the 70mm format with six channel discrete stereo, which continues to utilize magnetically striped prints similar to the old 35mm format but with six tracks instead of four. Stereo continues to be a popular release format and more and more pictures continue to be released in this form each year.

Feature motion pictures have been transmitted over television since television began in the late 1940's. The traditional film medium of supply was the 16mm print which, while it produced a usable image, has a monaural optical soundtrack of very limited frequency response, high noise and high distortion; definitely lo fi and non-stereo. When cable came along, the 3/4" U-matic cassette, usually made from the same 16mm prints used by TV stations, became the standard for those systems who wanted to originate their own movie showings. These again were lo fi, mono, and had a poorer quality picture than even the direct projection of 16mm film.

Today, however, things are changing. The recent advent of stereo VHS and Beta cassette recorders and of the Laserdisc and the RCA CED videodisc with high quality stereo audio have created a demand for motion picture in the home with high quality stereo sound.

The decision of MTV and The Movie Channel to transmit much of their programming in stereo creates additional demand for stereo film product. And, when the FCC approves stereo audio for television broadcast stations, the demand for stereo movies will again increase. It is also reasonable to assume that the other national pay movie services like HBO, Showtime, Disney, and local originators as well, will also convert to stereo transmission at some point in the near future.

Since the advent of the 35mm Dolby matrix stereo system, almost all of the major studios have been producing 35mm encoded mag track masters, containing the two matrix soundtrack signals, which are used to create a two-track Dolby optical printing negative. These matrix encoded mag tracks have a compatibility feature such that if they are played over a normal two-channel left and right stereo system, they will produce excellent two-channel stereo. The hidden, or encoded, center and rear surround channels are just not recovered. But, if the two-channel signal is played through a matrix decoder,

the center and rear surround signals can be heard and the full four-channel theater sound recovered.

For the past two years, 20th Century-Fox, and some of the other major studios, have been using Dolby matrix encoded mag track masters as the sound source for master videotape transfers of stereo film features. These video masters are then used as the source of pay TV, home video, and syndication tape and disc copies. This means, of course, that matrix encoded stereo is now and has been available to many home viewers, even though this fact has not been widely publicized.

While Dolby Labs do build matrix decoder systems for professional and theater applications, they do not manufacture units for home use. They have however licensed a company known as Surround Sound, Inc., in Santa Monica, California, to produce a home matrix decoder using a circuit of Dolby design. This Surround Sound unit is a scaled-down version of the Dolby theater system. It has been greatly simplified by the deletion of any gain shifting electronics and the elimination of a center channel output. It does have however a self-contained 20-watt power amplifier to feed the rear surround speakers and the proper decoder circuitry to produce left, right, and surround channels. The unit also includes an appropriate rear channel delay line and Dolby type B noise reduction circuitry. The system is quite satisfactory for use with a typical TV set or monitor when used in a normal sized viewing room where the rear speakers are not more than about 30 feet from the TV screen. The absence of a center channel is a disadvantage with large screen projection systems, but several other companies are now in the process of development of decoder units of a more sophisticated form. Audionics of Oregon in Portland, who make high end audio components, are working on a full four-channel unit with gain shifting, and Jensen Sound Labs of Chicago, who make high end component TV systems, are also developing a similar system. Fosgate Research of Prescott, Arizona, presently has on the market a high quality decoder that, while designed primarily for the SQ system, can also be used to decode Dolby matrix surround. This unit does have gain shifting, but no rear channel delay circuit.

The effect of using surround stereo with television viewing is a striking improvement in realism. It truly converts TV watching into a new experience much

closer to the experience of the theater. Instead of looking into the action from a separated location, the viewer becomes a part of the action environment; a technique that theaters have been using for years. Since excellent software product of this type is now available in any home video store, and the decoder hardware is now becoming readily available in the high fi and stereo equipment shops in the country, the public is starting to experience the tremendous improvement possible from this next step in home viewing technology. Since satellite, MDS, and cable can easily transmit the matrix stereo format and delivery to the home by FM cable simulcast is an easy and already used technique, there is no reason why cable cannot easily compete with the kind of home stereo being offered by both the theaters and the home video product of today.