Film-Tech

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The Evolution of Dolby Film Sound

With developments like multichannel digital sound in the cinema and video with surround sound in the home, the motion picture viewing experience today is more exciting and involving than ever before. And what the audience hears today, both in the cinema and at home, is very much the result of a continuing effort to improve film sound originally undertaken by Dolby Laboratories more than twenty years ago. Indeed, the evolution of motion picture sound over the past two decades is, in great part, that of Dolby film sound technologies.

Optical Sound

The photographic or "optical" soundtrack was the first method of putting sound on film, and today it remains the most popular.

An opaque area adjacent to the picture contains narrow, clear tracks that vary in width with variations in the sound (Figure 1). As the film is played, a narrow beam of light from an exciter lamp in the projector's soundhead shines through the moving tracks. Variations in the width of the clear tracks cause a varying amount of light to fall on a solar cell, which converts the light to a similarly varying electrical signal. That signal is amplified and ultimately converted to sound by loudspeakers in the auditorium.

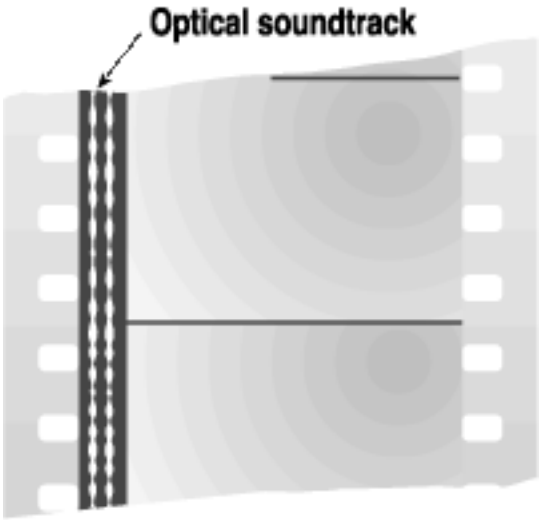

Figure 1

Several advantages of optical sound have contributed to its universal acceptance, the foremost being economy. For one thing, the soundtrack is printed photographically on the film at the same time as the picture. For another, the soundtrack can last as long as the picture, which – with care – can be a long time indeed. A further benefit is that the optical soundhead within the projector is itself economical and easily maintained.

Motion pictures with sound were first shown to significant numbers of movie-goers in the late 1920s. By

the mid-1930s, the "talkies" were no longer a novelty, but a necessity, and many thousands of theatres were equipped in that short time to show films with optical soundtracks. This phenomenally rapid acceptance of a sophisticated new technology was not without drawbacks, however. Equipment was installed in theatres so rapidly that there was no time to take advantage of improvements which were occurring on an almost daily basis.

A good example is loudspeaker design. The first cinema loudspeakers had very poor high-frequency response. Speakers with superior high-frequency capability became available within just a few years. But there was no time to retrofit the original systems with new units, because engineers were too busy equipping other theatres with their first sound installations.

This caused a dilemma for soundtrack recordists. Should the tracks be recorded to take advantage of the improved speakers, or should they be prepared to sound best on the many older installations already in place? Given that it was impractical to release two versions of a given title, the only alternative was to tailor soundtracks to the older speakers. The result was to ignore the improved high-frequency response of the newer, better units.

To forestall compatibility problems, in the late 1930s a *de facto* standardization set in, the theatre playback response that today is called the "Academy" characteristic. Theatre owners knew what to expect from the films, and therefore what equipment to install. Directors and sound recordists knew what to expect from theatre sound systems, and thus what kind of soundtracks to prepare. The result was a system of sound recording and playback that made it possible for just about any film to sound acceptable in any theatre in the world. It was also a system, however, without the flexibility to incorporate improvements beyond the limitations that existed in the 1930s.

Even with these limitations, for years optical film sound provided higher quality sound than home phonographs and radios. But by the late 1960s and early 1970s, superior hi-fi stereo systems had been installed in so many homes that a significant and influential proportion of the moviegoing public was used to better sound at home than could be heard in the theatre.

Magnetic Sound

In the 1950s, a new method of putting sound on film was introduced as an alternative to the optical soundtrack. After the picture is printed, narrow stripes of iron oxide material similar to the coating on magnetic recording tape are applied to the film (Figure 2). The sound is then recorded on the magnetic stripes in real time. In the theatre, the film is played back on projectors equipped with magnetic heads, similar to those on a tape recorder, mounted in a special soundhead assembly called a "penthouse."

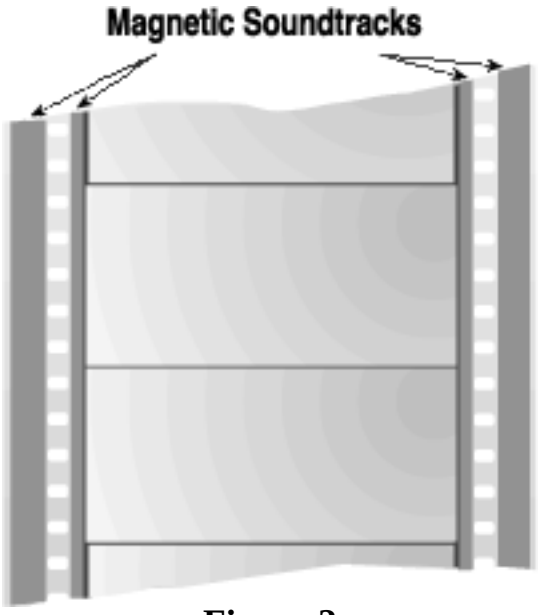

Figure 2

Magnetic sound was a significant step forward, and at its best provided much improved fidelity over the conventional optical soundtrack. Magnetic sound also permitted the multiple tracks required by stereophonic sound. The voice of an actor appearing to the left, center, or right of the picture could be heard coming from speakers located at the left, center, or right of the new wide screens also being introduced at this time. Music took on a new dimension of realism, and special sound effects could emanate from the rear or sides of the theatre. The two main magnetic systems adopted were Twentieth Century Fox's four-track 35 mm CinemaScope system introduced for *The Robe*, and the six-track Todd-AO system first used for such 70 mm films as *Oklahoma!* and *Around The World in 80 Days*.

Many theatres were equipped for magnetic sound in the 1950s, even though the playback equipment was expensive. Many films were issued with magnetic soundtracks, although magnetic prints were, and remain, much more expensive than optical sound prints (35 mm magnetic prints cost at least double their optical equivalents, and today's 70 mm magnetic prints cost up to fourteen times as much).

By the 1970s, however, the film industry declined overall, with fewer films and fewer theatres. The expense of magnetic release prints, their comparatively short life compared to optical prints, and the high cost of maintaining magnetic theatre equipment led to a massive reduction in the number of magnetic releases and theatres capable of playing them. Magnetic sound came to be reserved for a only handful of first-run engagements of "big" releases each year. By the mid-1970s, movie-goers were again usually hearing low fidelity, mono optical releases again, with only an occasional multitrack stereo magnetic release.

Dolby Gets Involved

The situation that prevailed in the mid-1970s completely changed by the late 1980s. Thanks to new technology and a turnaround in the financial decline of the industry, almost all major titles today – accounting for 80% of the boxoffice – are released with wide-range multichannel stereo soundtracks.

The breakthrough was the development of by Dolby Laboratories of a highly practical 35 mm *stereo* optical release print format originally identified as Dolby Stereo. In the space allotted to the conventional mono optical soundtrack are two soundtracks that carry not only left and right information as in home

stereo sound, but also information for a third center-screen channel and – most notably – a fourth surround channel for ambient sound and special effects.

This format not only enabled stereo sound from optical soundtracks, but higher quality sound as well. Various techniques are applied both when the soundtrack is recorded and when it is played back to improve fidelity. Foremost among these is Dolby noise reduction to lower the hissing and popping associated with optical soundtracks, and loudspeaker equalization to adjust the theatre sound system to a standard response curve.

All this means that these prints can be reproduced in theatres with Dolby-manufactured cinema processors with far wider frequency response and much lower distortion than conventional soundtracks. In fact, the Dolby optical format has led to a new worldwide playback standard (ISO 2969) for wide-range stereo prints, just as the "Academy" characteristic applies for mono prints.

An important advantage of the Dolby optical format is that the soundtracks are printed simultaneously with the picture, just like mono prints. Thus a four-channel stereo release print costs no more to make than a mono print (although it is more expensive to record and mix in stereo than in mono). Conversion to Dolby Stereo optical is relatively simple – more than 25,000 theatres worldwide have done so – and, once the equipment has been installed, very little maintenance is required, particularly when compared to magnetic stereo playback systems. Moreover, print life is as long as that of conventional mono optical prints, unlike magnetic prints. The result is multichannel capability equalling that of four-track magnetic 35 mm (made all but obsolete by the stereo optical format), consistently higher fidelity, and few of the drawbacks of magnetic formats.

Much of the new technology, including noise reduction and equalization, also is applied to 70 mm magnetic releases (also originally designated as Dolby Stereo). Although 70 mm release prints continue to be very expensive, Dolby improvements brought a resurgence of interest in this "big" format for road shows where the ultimate in picture and sound presentation is particularly likely to be reflected in box office figures. There are six magnetic tracks on 70 mm film, two of which carry low bass effects. Some 70 mm films also use a technique developed by Dolby Laboratories to provide two separate surround channels in addition to the left, center, right, and bass effects screen channels.

The Next Step: Dolby SR

In 1986, Dolby Laboratories introduced a new professional recording process called Dolby SR (spectral recording). Like Dolby noise reduction, it is a mirror-image, encode-decode system used both when a soundtrack is recorded and when it is played back. It provides more than twice the noise reduction of Dolby A-type, and, moreover, permits capturing loud sounds with wider frequency response and lower distortion.

35 mm optical soundtracks treated with Dolby SR instead of Dolby A-type not only sound superb in the more than 8,000 theatres equipped with special SR processors, they also play back satisfactorily in *any* theatre. As a result, most SR titles are released single inventory. In fact, in theatres equipped with regular A-type processors, the moderate compression that results helps prevent the louder peaks on SR soundtracks from overloading the theatre's sound system. This feature further obviates the need for separate mixes and releases.

And Now, Dolby Digital

The newest film sound development from Dolby Laboratories puts a six-channel *digital* optical soundtrack in addition to a four-channel SR analog track on the same 35 mm prints (Figure 3). This Dolby Digital format is yet another significant step forward in film sound, providing independent left, center, right, left surround, and right surround channels, plus a sixth channel for bass effects.

Figure 3

In addition to multiple channels, the Dolby Digital track provides extraordinary dynamic capability, wide frequency, range low distortion, and relative immunity to wear and tear. The format has already proved its unique combination of high quality, reliability, and practicality in theatres around the world. And because the digital track is right on the film, the format has none of the drawbacks of separate disc systems.

As with previous Dolby developments, Dolby Digital does not obsolete existing theatre installations. The prints can be played conventionally in any theatre, while the digital optical track can be reproduced by adding digital readers to the projectors and a digital decoder which interfaces with the theatre's existing Dolby cinema sound processor.

Making Films Sound Better

Dolby format release prints and the equipment which reproduces them are only links in a chain that extends from the original location, through the dubbing theatre, to the laboratory, and finally into the theatre. Developments like Dolby SR and Dolby Digital ensure that the soundtrack itself remains one of the strongest links. But just like high-quality CDs played on the best home stereo equipment, Dolby formats are capable of carrying a higher fidelity "message" than previously–and so can reveal the quality of each step in the recording, mixing, and dubbing processes. Taking advantage of the new formats has thus required new approaches to soundtrack production. Admittedly, the results can vary–the final reproduced soundtrack can be no better than the elements it comprises–but Dolby film sound at its best means not only better quality sound, but sound in the theatre that consistently realizes the director's original intentions.

While Dolby's involvement with film sound first achieved wide recognition with the spectacular audio effects of such films as *Star Wars*, it has long since come to mean more than just special or dramatic

effects. The objective is high quality sound reproduction overall—dialogue and music, as well as effects. Dolby technology is a means, not an end. It can be likened to an artist's palette that provides the director with a full range of colors, where before there were but a few. Above all, Dolby formats have been developed to enhance that very special experience of going to the movies.