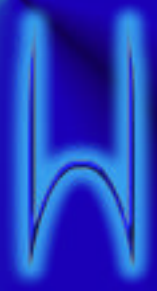

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Sound IS the Experience !™

DIGITAL STEREO FOR THEATRES:

HOW IT WORKS AND HOW TO BE READY

BY

JOHN F. ALLEN

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DIGITAL STEREO FOR THEATRES:

HOW IT WORKS AND HOW TO BE READY

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Anyone who has experienced the pure enjoyment of listening to a compact digital disc realizes why they have become so popular. In the past few years, the recording industry has worked hard to convert their facilities to digital. Most classical recordings are now done digitally. The film industry is now beginning to use this advanced technology. Recording studios such as Glen Glenn Sound, Disney, Oasis Studios and Warner Hollywood Studios are using digital systems more and more. But presenting films digitally in theatres has been thought to be years away.

Some of us have believed the potential of digital to enhance the motion picture experience is so great, that we couldn't wait. Last December Glen Glenn Sound, Oasis Recording Studios and I got together in Los Angeles with Plitt Theatres and presented the world premier of digital sound in a commercial movie theatre. It now appears as though this one superb sounding presentation has indeed changed the entire direction of cinema sound.

The digital recordings were so clear and obviously superior to anything ever before heard in a theatre, that Plitt Vice President, Edward M. Plitt began (that very afternoon) to search for the earliest opportunity to present an entire feature film in digital stereo. We discussed METROPOLIS, as we had used it for our presentation. But then Walt Disney's classic masterpiece FANTASIA was booked into Plitt's Century Plaza Theatre in Los Angeles and the opportunity was at hand. On February 8, 1985 with the considerable help of the Walt Disney Pictures' sound department, FANTASIA became the first film in history to be exhibited in digital stereo. The grosses were very strong; $150,000.00 in eight weeks, $36,000.00 for just the opening weekend. (See BOXOFFICE July 1985, page 23).

Another forward thinking executive, Washington Circle Theatres' CEO, Thomas S. Perakos, contacted me in late February and expressed his interest in our HPS-4000™ sound systems and his desire to present the east coast premier of FANTASIA in digital sound at their Avalon Theatre. On May 28th the presentation opened to tremendous reviews and public acclaim. Again, grosses were strong. Interestingly, when the film was moved over to another non-digital theatre, the weekly gross dropped a whopping 63 per cent. This would seem like dramatic evidence of digital's drawing power.

I don't think it's too much to say that digital holds the promise of a stronger and more profitable future for exhibitors. But, how does it work?

PULSE CODE MODULATION

In the past, we have used so called analog recording methods. This is to say that the wiggles in the grooves of a long playing record are analogous to the sound. If the pitch gets higher, the wiggles get closer together. If the sound gets louder, the wiggles get deeper and so forth. The current 35 MM optical soundtracks also use analogous wiggles to store sound signals.

In the simplest terms, what digital does is to measure the sound signal and convert it into binary digits, ones and zeros, and stores the numbers on the recording tape or disc. On playback the numbers are converted back to the original sound signal. When compared to current soundtracks, digital offers far less noise and distortion as well as more dynamic range. This can be used to add dramatic impact.

The digital conversion process is generally done 48,000 times every second. This is called the sampling rate. The sound signals are divided into 48,000 samples per second and each of these samples is then measured and converted into a numerical representation by a process known as quantization.

To understand how this is done, imagine a sine wave with a frequency of one full cycle per second. Graphically it would look like this:

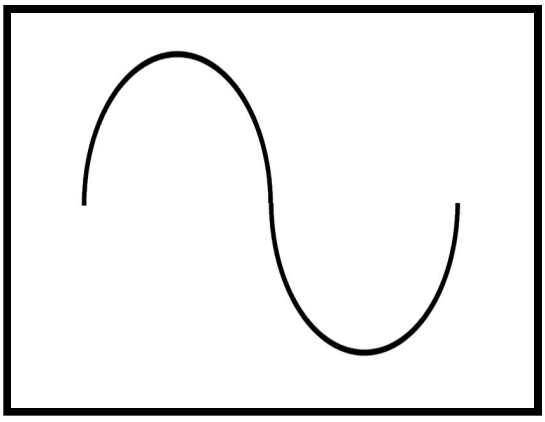

Figure 1.

Now divide the waveform into say just six samples. The six samples would then look like this:

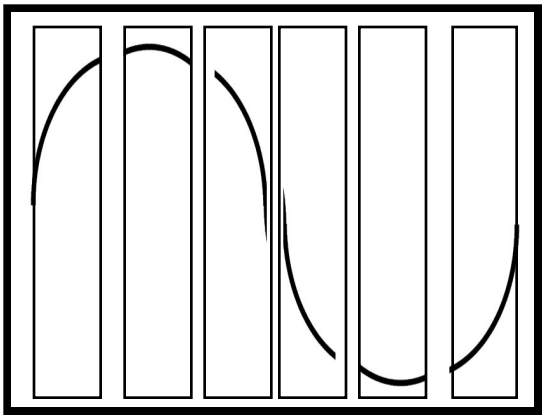

Figure 2.

Now let's take the first sample and measure the instantaneous signal level, First we divide the sample into upper and lower halves. We then ask "is the signal level above or below this point?" If the answer is "above", we write down a "1". If the answer is "below", we write down a "0". We then take the upper or lower half where the signal level is and divide it again. Again, we ask the same question and get another "1" or "0". This questioning is done 16 times for each of our six samples. Each 1 or 0 that we get is called a "bit". If we have 16 ones and zeros from our 16 questions, then we are using what is called a 16 bit system. Each 16 bit number is called a "word" and digitally represents the signal level or modulation of the sound signal at that instant. In actual digital systems we don't do this six times per second, of course, but 40 to 50 thousand times per second, depending on the system. Each sample has a 14, 16 or 24 bit word, again depending on the system.

Some of these bits are used for error correction. This is necessary for those times that the digits fail to show up as they are supposed to at the moment of playback. When errors occur, the instantaneous signal is still reconstructed using a variety of sophisticated error correction techniques including redundant, or back up bits, stored elsewhere in the recording.

If the numbers are really scrambled or missing altogether, we get silence - no sound at all. Incidentally, there were no such "drop outs" during any performance of FANTASIA. This type of digital sampling and conversion is called Pulse Code Modulation or PCM.

To understand the PCM digital playback process, let's return to the example of six samples of a one cycle per second sine wave. The l's and 0's stored in the recording tell the

digital to analog converter that our six samples look like this:

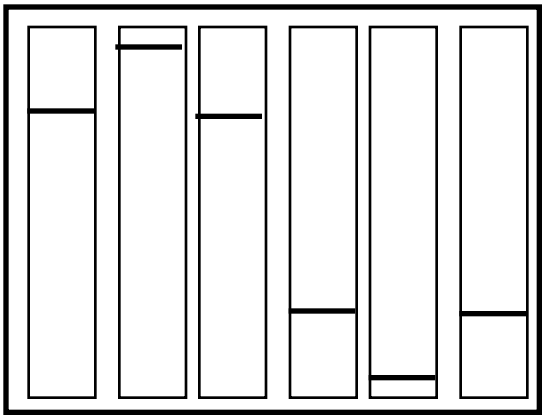

Figure 3.

This, in essence, appears as six square waves or steps perhaps. This is passed through a smoothing filter which removes the corners from the square waves and gives us back the original sine wave:

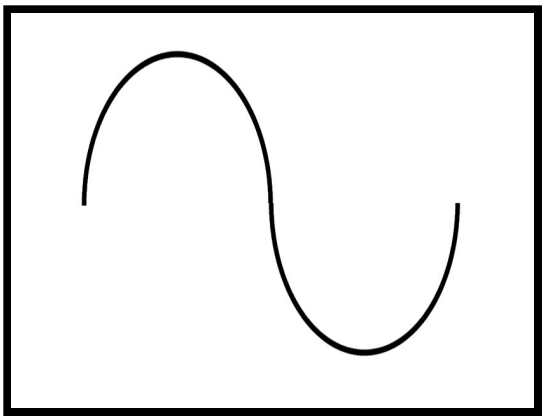

Figure 4.

When playing a digital recording, we are only listening to the sound signal as it reappears at the output of the playback digital to analog converter. What we are not listening to is the noise and distortion of the recording medium (tape, optical, etc.). Without the noise and distortion, the sound appears more nearly live. The difference can be enormous especially when you consider that for motion pictures, the sound is rerecorded several times during the production process. In digital, only the numbers are transferred to the new recording generation. There is no build up of noise and distortion from generation to generation. The final digital mix is virtually a clone of the original

sounds. Unless you have actually experienced the full potential of this improvement, it's hard to believe the magnitude of the difference.

Another major advantage for theatres is that digital stereo will not suffer the constant degradation from the projector which we are so accustomed to with analog. As long as the numbers remain intact and readable, the sound will remain as good as it is on opening day.

DOUBLE vs. SIGNAL SYSTEMS

Up to now, our PCM digital stereo presentations have utilized a double system where the sound recording was on a separate playback unit and synchronized with the picture. Disney's digital interlock system makes this simple to do. As reliable as it has been however, for large scale releases in digital stereo, it is desirable that the sound and picture be together on a composite print. It now appears that this technology may actually become available sometime in 1986 as several companies are working hard to solve the problem. A few studios are already mastering some or all sound mix elements digitally for certain productions. More are gearing up. So, with any luck we may actually hear digital stereo in theatres on a growing scale sooner than anyone has believed.

DIGITAL READY SOUND SYSTEMS FOR THEATRES

Of course, most theatre sound systems will need to be beefed up to handle digital's greater dynamic range demands. A large percentage of the present theatre sound systems are as obsolete as the Model T and are totally incapable of the dynamic range afforded by Dolby Stereo let alone digital. All that's required are new amplifiers and loudspeakers. Had these been installed with the advent of Dolby Stereo, as they should have been, the industry would now be digital ready, which, of course, it is not.

Each channel of a digital theatre sound system, including the surrounds, will need to be powered to produce peak program levels of around 105 dB sound pressure level. Adding a minimal safety margin on top of that, digital sound systems should be able to produce about 111 dB per channel in the middle of a theatre. This is not at all difficult or expensive if efficient speakers are used. If inefficient speakers are used, it gets complicated and very expensive. This is one reason I've always used efficient loudspeakers.

The challenge to our industry is here. For myself, I see the growth of home video and see a future where people will only go out of their way to experience films in those theatres with the best sound systems. Without the qualities of great sound, picture and comfort, I doubt there is much of a future for theatre going. People will prefer to stay at home to watch their movies where it's more comfortable and where it sounds better.

John F. Allen is the founder and president of High Performance Stereo in Newton, Mass. He is also the inventor of the HPS-4000® cinema sound system and in 1984 was the first to bring digital sound to the cinema. John Allen can be reached by E-mail at JohnFAllen@aol.com.