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The Insiders

This month's focus:
Digital Cinema

Digital Cinema or Film?

by Steven J. Thorburn, PE

Having just returned from **Sho-West**, the annual west coast cinema trade show, where films are screened and theater seats, theater concessions, and theater projection systems are displayed, I only saw two vendors on the floor who had the courage to exhibit *film* projectors. All the others, **NEC**, **Sony**, **Barco**, and **Christie**, were pushing digital projectors.

I have been a fan of digital projection ever since 1996, when I had the privilege of working on the Los Angeles InfoComm Special Event Theater, said to be the first public screening of digital cinema. The entire visual system was digital up to the point the image left the projector. The content, stored on digital videotape, was sent straight to a **Hughes/JVC** D-ILA light-valve projector. Attendees were stunned by this promising new audio-visual medium.

Digital cinema has come a long way since and has some excellent applications for theaters, but still isn't the best choice for every situation. There are benefits: print costs go away, the last run of the show is just as good as the first, a multiplex can quickly reschedule theaters based on today's ticket sales.

But for theaters with screens wider than 20 feet (6 meters), you pay a price in image quality. Today's DCI-compliant systems supply what I would describe as only slightly better than really good broadcast TV, and only one-fourth to one-tenth of the picture information you could see in the typical 35mm movie house. (DCI is the **Digital Cinema Initiative**, developer and keeper of standards for the industry.)

I could spend the rest of the article discussing what parts of the image are being thrown away. Instead, here's an analogy: Think back about 15 years, to the dot matrix printer. You may have had one connected to your computer. If you shelled out big bucks you could even get a color dot matrix printer. Remember what a printed page of words looked like? At around 24 dots per inch, it was readable, but nothing like the quality of text that you are reading now.

The needs of museums, educational institutions, and conference venues differ from those of the cineplex, and digital cinema as it is right now does not always meet them. DCI-compliant projectors get you 2,048 dots, or pixels, across the width of your projected image, whether your screen is 20 feet wide or 100 feet (6 meters or 30 meters). The equivalent resolution in film, depending on the physical size of the film stock (from 16mm all the way up to 15/70) is in the range of 8,000 to 20,000 pixels across the width of the screen. Going back to the printer analogy, would you buy the argument that your current high-res color laser printer should be replaced with an old dot matrix?

DCI has done a great job in setting the bar as high as possible for right now. And right now, for best results, the image size in a digital cinema auditorium should be limited to about 20 feet wide. And the best seats in the house are going to be at least 20 feet away; any closer and a critical viewer can see the dots that make up the image. This is based on my observations of numerous film and digital projection systems over the last 30 years, as projectionist and system engineer, including my experience in the certification of LF theaters.

Why can't DCI set the bar higher right now? It's the chip. The industry's primary chipmaker, **Texas Instruments**, currently makes a 2K (1080x2048-pixel) chip. The image on the chip is updated between 24 and 144 times per second. The highest frame rate permits single-projector 3D by flashing each frame of each eye three times (24x2x3=144).

Of course, the industry is working to improve image quality. Sony has a 4K system. JVC has a process that claims even higher resolution, shown last year at the **National Association of Broadcasters**' conference. Some systems blend images from multiple projectors. (At least one firm claims it can blend 100 projectors together — think about the commission on that sale! Better yet, buy stock in the lamp manufacturer before you sign the deal.) Some fresh advances may be unveiled at NAB's Digital Cinema Summit in Las Vegas this month.

Getting back to today's DCI-compliant projector, for the sake of easy math, let's say it has 2,000 horizontal pixels, and we project it onto an 80-foot-wide giant screen. That gives 25 pixels per foot, or about two pixels per inch. Put the same image on a 40-foot wide multiplex screen: 50 dots per foot or 4.2 dots per inch. Better, but I still would not want to be sitting in the front row. In film terms, you would have a very grainy image. So if you want to provide an immersive experience showing the breathtaking vistas of Africa or outer space, or a visually detailed nature, history, or science documentary, for now you should stick with film.

On the other hand, if you are installing or updating a small, 40- to 200-seat theater, then let's look at digital. On a screen 9 feet high by 16 feet wide (3 meters by 5 meters), you will have about 120 pixels per foot, depending on the projection system you select. This is much better than the "grainy" 25 pixels per foot in the giant-screen example above. But note that it doesn't compete with the quality of good home theater. It is a far cry from the 480 pixels per foot that give me a picture window to the world on the digital flat panel in my home.

The advantage of a small, digital theater system with DCI-compliant projectors is that it makes a great, versatile screening room with options far beyond what you get with a film projector. Content changeovers are very fast. A good laptop can drive the system. Your theater becomes a space you could rent out for corporate meetings, educational sessions, or other purposes. If the projector has a DVI input port and the computer has the same output (anything sold in

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the last 18 months does), the system is even more versatile. Digital cinema also greatly simplifies 3D presentation, and 3D is hot right now. There are systems on the market that will allow you to change over from 3D to 2D in seconds.

One might assume that 3D projection puts twice the information on the screen, because it is transmitting separate images for the left eye and right eye. But for practical reasons, single-projector 3D systems reduce the amount of information in each frame, with the result that the visual quality is roughly the same as 2D. And 3D has other issues, one being it reduces the number of seats from which the audience can get an optimal view. To make the most of a 3D installation, be sure that it also gives a good 2D experience.

So what should you buy? When working with our clients, we always start our line of questions with a statement: Do not think about the technology. Tell us what you want to do in your venue. What are the program needs for the space? If you have a mission, what requirement does that bring to the table?

If you have a small theater that has multi-use needs or if you can produce your own show in full high-def video, then a digital projection system is what to look for. If, however, you want or need high-quality visual resolution and color depth, these are still much more attainable in the realm of film.

Steve Thorburn of Thorburn Associates Inc. is an independent acoustical and technology consultant and a licensed professional engineer. In the 1980s he worked on projects for George Lucas, Dolby Labs, and Disney as a project engineer developing and overseeing the acoustical design and construction of film production studios and screening rooms. In the mid-1990s he provided quality certification of LF theaters. He can be reached at Steve@TA-Inc.com.