

A New Approach for 3D in Digital Cinema

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Abstract

With the success of features in 2007 and 2008, 3D cinema is now all the rage in Hollywood. The major studios and key-industry directors have now targeted major 3D releases for 2009 with over 14 features slated for release. In the past, 3D itself had never quite achieved a phenomenal and sustaining success despite having reached scattered peaks of excitement. In this paper, we discuss 3D technologies for cinema along with our development and try to understand the past failures and consider if the current wave is real this time.

1. Stereoscope Arrivals

Just as the stereophonic can be realized by a sound source that is heard slightly differently by left and right ears, a pair of correlated but different images, one for each eye, can create a stereoscopic sensation. This basic understanding has been around for a quite long while. The first attempt of stereophonic film with motion pictures was in 1934 by Alan Blumlein in Bell Laboratories in which he used a pair of bi-directional microphones. The stereoscopic visual attempts actually came earlier than Blumlein's stereophonic attempt. The very first was the red/green anaglyph format, and in 1922 a film titled "The Power of Love" was premiered in Los Angeles to the paid audience wearing

anaglyph glasses. The system used a dual-strip projection.

A switching 3D format arrived a few months later in 1922. Televue system was the development of Laurens Hammond and William Cassidy that projected alternating left-view/right-view frames sequentially by two projectors interlocked each other. The viewer with synchronized shutters was installed to the audience seat.

The polarized filter was an invention of Edwin Land in late 20's, which eventually made its way to 3D movies in 1936. With Polaroid glasses, it could remove the switching mechanism in the viewer while offering a more elaborate filtering than anaglyph, but it required a silver screen to ensure the correct reflection of polarized images.

2. Efforts to Grow

In 50's, the movie industry faced with the penetration of television in home which was perceived as a serious threat to their business. The public now had an alternative form of entertainment on a Saturday night besides their local movie theatre or drive-in. They had to create something that the television could not offer, and the efforts were focused in two areas: Large screen and 3D. At this time, the color was already an essential element and the 3D technology was concentrated around the polarized system while the

red/green anaglyph with disposable paper glasses was seen more as a feature in comic books.

“Bwana Devil” was the first stereoscopic feature film in color, released in 1952 by United Artists. All the major studios such as Columbia (“Man in the Dark”), Warner (“House of Wax”), Disney (“Melody”), Fox (“Inferno”) and MGM (“Kiss Me, Kate”) joined in the boom in 1953. Although some of these films were well received by the public, the 3D productions showed the decline in 1954 with the arrival of Cinemascope and 70mm Todd-AO formats. In essence, such factors as dual-print and its production complexity, synchronization issue, and sliver screen were the apparent shortcomings in comparison to widescreen formats.

Further down in 80’s, IMAX realized a marriage of 3D and large screen with their 3D system that debuted in 1986 at Vancouver Expo. They used to use active LCD glasses that electronically switch in synchronization with the screen. In years that followed, they added a polarized solution.

3. Dolby 3D Solution

A totally new approach in the mechanism of realizing 3D was developed by Jorke Helmut and others in Daimler-Chrysler Research Center in 2001 originally to display stereoscopic still images for more realistic, quality automobile designs. The new technology is called “wavelength multiplex” as it allows different set of RGB signals transmit by shifting their wavelength slightly each other. The filtering is practically achieved by splitting

each bandwidth of RGB, the upper or the lower band-set of which is assigned to the left or the right eye.

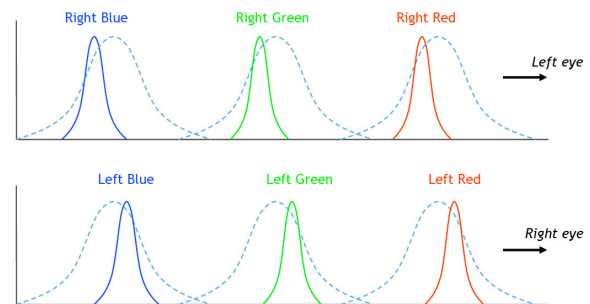


Fig.-1: RGB wavelength multiplex

In 2007, Dolby applied this technology in the digital cinema projection.

For digital cinema to avoid flickering, the film rate of 24 fps is tripled to 72 fps for each eye, and the projector is thus required to handle total 144 frames per second. A color filter wheel is placed between the lamp assembly and the DLP light engine device within the projector to ensure minimum impact to the image quality, rotating at 4320 rpm as controlled by the DFC-100 Controller Unit in sync with the image data file being processed by Dolby Digital Cinema system.

In our study of 3D technologies, we classified the past system problems with 3D in two categories: performance and practicality. In our case, we examined the solutions for digital cinema rather than the film. This was because the mechanical nature of film as an analog system had a lot to do with 3D quality. For example, the image localization is never stable precisely with the running film, and human eyes keep trying to track the subtle variation to maintain the 3D focus, which is fatiguing. Digital projection achieves the exact image

stability hence eliminates the above problem. This factor is perceived probably as the most substantial difference in digital 3D by the audience.

As for the polarized system currently dominant in the market, regardless of analog or digital, the polarization filter functions as reducing the resolution in analogous sense, and particularly degrading the sharpness, but more significant is its requirement of high-gain, silver screen to secure the separation and to compensate for the loss of gain, but resulting a narrower service area in the auditorium.

It is interesting to note that the performance is always an important factor, but in parallel how many practical advantages you can present to industry stakeholders often impacts the direction. In this sense, digital system is much more practical in terms of projection, some of such properties are explained in the chart-1.

4. Other aspects to consider

Separation: With the RGB band-splitting filter, the image resolution is intact and the most advantageous is the ideal

left/right separation that consequently establishes an unmatched 3D sensation.

It also enables virtually ghost-free performance with high contrast pictures, particularly advantageous for subtitles.

Color Accuracy: The filter wheel insertion in front of DLP light engine is considered as digitally processing the color, thus least influence on colors.

Color Correction: Through the RGB filter, the left eye image slightly leans toward red while the right eye image leans toward green due to left-red's or right-green's proximity to each maximum level, although the composite (left+right) view looks natural. This color displacement is corrected in real-time during playback from the Digital Cinema Server.

3D Glasses: The light-weight passive glasses with numeral high precision color layers of exactly the same color property as the filter wheel are designed for multiple uses of more than 500 times. Professional dishwashing machines are suited for cleaning in cinemas, and provide an environment-friendly as well as economical solution when compared to disposable glasses. An anti-theft protection tag is integrated in the eyewear frames.

	Optical film	Digital cinema	Advantage
Image localization and focus	Mechanical fluctuations	Absolutely stable image	3D stability with less fatigue
Projection	Dual film projection bulky/cumbersome	Single projection, data in files	Less burden on cinema
Film maintenance	Paired splicing is impractical	No tears/wears	Maintenance-free
3D rendering	Analog-transfer is extra down-grading process	Digital process friendly	Ease of production

Chart-1: Film v.s. Digital Comparison

	RGB Bandsplit	Polarization	Remarks <+>
3D Filter	Inside the projector, pre DLP engine <+>	Outside projector lens, post DLP engine	Color accuracy and sharpness.
L/R separation	Excellent <+>	Moderate	3D quality
Mastering Prep.	None needed <+>	Ghost-busting pass	Efficient
Screen	Regular white <+>	Silver	2D/3D flexibility
3D glasses	Light, expensive, repeated +500 uses	Light, inexpensive, disposable use	
Installed-base	379*	2000	*as of September '08

Chart-2: Digital Format Comparison

Screen: Replacement of screens between the white and the silver back and forth for 2D/3D presentations is extremely expensive in reality and often impossible physically because the screen may have been installed during the theater construction.

3D Effects: The movie is an art form of entertainment. One thing we consider critical is the usage of 3D effects that deal with the sensation of audience. Regarding its control for example, any abrupt scene changes require the brain to recalculate the distance to focus, thus less suited for 3D than 2D. Such discussions are happening among the production people in USA already exchanging thoughts and findings.

We believe controlling the image effect natural and yet thrilling will after all ensure a comfortable and safe experience.

5. Conclusion

While engineers have been able to provide a practical solution with satisfactory performance, it is really up to the content creators to be able to light up the screen. Just as surround sound became standard in film and occupies a certain space at home through the industry's efforts, we believe 3D will and can reach the same plateau.

6. Reference

Jorke, H., Fritz, M., "Infitec - A New Stereoscopic Visualisation Tool by Wavelength Multiplex Imaging"

US Release Date	Distributor	Title
Jan. 16, 2009	Lionsgate	My Bloody Valentine 3-D
Feb. 6, 2009	Focus Features	Coraline
Feb. 27, 2009	Disney	Jonas Brothers Concert Movie
Mar. 27, 2009	Paramount	Monsters vs. Aliens
May 29, 2009	Disney	Up
July 1, 2009	Fox	Ice Age: Dawn Of The Dinosaurs
July 24, 2009	Weinstein Company	Piranha 3D
July 24, 2009	Disney	G-Force
Aug. 14, 2009	Warner Bros.	Final Destination 4
Oct. 2, 2009	Disney	Toy Story
Nov. 6, 2009	Disney	A Christmas Carol
Nov. 20, 2009	Sony	Planet 51
Dec. 18, 2009	Fox	Avatar
Dec. 25, 2009	Disney	The Princess and the Frog

Chart-3: Scheduled Release Titles in 2009