STEREO TIPS

Myths and Physics

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STEREO TIPS: Myths and Physics

Contents

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Welcome to 3D!

This document is an illustration of some common truths and misconceptions embodied in Stereoscopic cinema capture and presentation methods. The objective is to review the most basic 3D parameters with more guided experience from Director of Photography and Stereographer, William Reeve csc.

1. Be meticulous about alignment

This is particularly true when dealing with vertical and rotational alignment. Vertical separation in images is the easiest to fix at the camera and in post-production. Rotational errors are more difficult to fix but a little easier to fuse in projection, however it causes more serious concern when the 3D image is a plate for computer animation and Visual Effects.

2. Try to avoid or mediate high contrast subjects

Contrast is good. Contrast creates the illusion of sharpness more so than resolution. Contrast is good and valuable to 3D because it helps to improve the character of our natural perception which is generally sharp and with good contrast. The statement is probably dealing with Ghosting or "cross talk between eyes from inefficient filtration in 3D glasses. Today, great improvements are being made with more efficient projection techniques. As a stereographer, you should think twice about suggesting lowering contrast simply to avoid ghosting; rarely can this be done without totally disrupting the aesthetics of the scene.

3. Wide angle lenses are friendlier to 3D capture and delivery

This is very true to a certain extent; 3D is a wide-angle medium but wide-angle lenses have their limits in dramatic narrative filmmaking. It is more important to say: *"Use the widest lens possible to get the desired frame size <u>without</u> causing unwanted distortions of the subject."* Use normal lenses as you would in feature film work and remember that every millimeter of focal length you add to the camera lens is closer to image compression and the artifacts there-of, for example: the cardboard cut out effect on long lenses with wide I/O.

4. Slower longer cuts are friendlier to 3D edits

Slower longer time between cuts is friendlier to 3D edits if there is a radical difference in Parallax between one shot and the next. The time between edits, however, is not as important as allowing the viewers eyes to adapt and change binocular ranging to settle on a new value of parallax. Faster edits can be done if the parallaxes of the most significant subjects are of similar value. Pulling parallax in post, near the cutting point in direction of the next shot can also help in fast pace editing.

5. Pace your depth. The amount of depth should vary to serve the story telling

It is only possible to vary or control the depth perception of a scene in stereoscopy by changing the focal length of the lens! With a wider lens we see more depth perception; as the focal length increases the amount of depth compresses. The 3D, that we can control, deals only with binocular ranging. It is possible to shift the apparent (virtual) position of the entire scene, including all objects, toward or away from the audience. Changing the lens interocular varies the size of subject and the scene. When adding parallax and moving the subject into the theater, the resulting parallax reduces the vertical size of the subject because the vertical viewing angle shrinks as it approaches the audience. One must strive for the correct apparent distance of the subject, to preserve realistic proportions and reduce excessive on screen parallax. Too much negative (in front of screen) and too much positive parallax (behind the screen) can both cause eye strain. It is more important to actively avoid these extreme conditions than concentrate on varying so called depth control.

For those who have studied 3D theory: Expanding or contracting depth perception without a focal length change is only possible by total reconstruction of the entire scene. The depth of the scene is determined when the focal length of the lens is chosen and placed on the camera. During photography all elements (objects, subjects) will have proportional parallax values that are determined by their distance from the lens and the interocular spacing. The stereographer has control of the viewer's **apparent distance** of the scene in the theater and the entire scene's vertical size. All objects behind the closest object to the lens will have a parallax value proportional to the nearest object, and those proportions do expand and contract either by convergence or interocular distance of the lenses. However, as the size changes so does our perception of where the subject "apparently" is and the perception of depth remain proportional to the parallax associated with the focal length and the lens spacing. Do we have control of depth? Can we "pace our depth"? The laws of physics combined with our brain's struggle to normalize what we see on the screen make it exceedingly difficult change perceived depth. Perhaps we should be more focused on avoiding excessive parallax and the proper use of convergence when necessary. Do not be fooled by statements such as: "With post-production tools the stereo depth can be controlled by convergence." The term "*pulling convergence*" in post is just really pulling net on sensor parallax which will create a convergence point in the scene with positive parallax in the back ground. There is very little net result of this adjustment in terms of Depth Control. What is important is that this technique is simply used to avoid excessive negative parallax in the foreground, avoid miniaturization and reduce eye strain – not really to adjust the stereo depth.

In Summary: During capture and in post we can easily position the subject more or less in the theater or behind the screen and adjust the image vertical size to the tolerable limits of the human eye. Caution is advised when continuously using convergence that drives into excessive positive Parallax.

6. Compose your shots with an eye toward Z-axis placement of all objects

Rather than disagree with this approach, I will expand on this tip with a slightly different view. This type of composition style could suggest a form of tunnel vision. The centerline of the lenses should be a determining factor in completely symmetrical composition like interior cockpit view straight on a fighter pilots head and shoulders with wing elements in the background; not so much in any other form of framing. The pseudo centerline of most compositions varies on the vertical height, center frame, in various formats from TV which tends to be center x y and IMAX © which needs to be lower in frame and with more headroom. The important detail is to shift the apparent Z-axis up and down depending on what is in foreground and background looking up or down etc. As far as attention to Z-axis I use it is a balance point for scenes intended to be scanned around. The balance point shifts up or down depending on the format. Further more, the Z-axis is the focal point of our natural tendency to look directly at what we are interested in; it is important to centralize the subjects that we demand of the audience to participate in. It is dangerous to place an irrelevant object directly in the x y center of a frame because eyes will lock on it very quickly at risk of ignoring the actual subject.

7. Keep your Camera moving at all times [when possible]

I agree but advise that the criterion should be followed when necessary and not when ever possible. Just for the sake of being on a dolly is not a reason to move the camera to create perspective shifting. There are many shots that demand a static reference point and grounding the camera to allow subjects to move throughout spatial planes. Moving the camera almost always suggests a third person subjective point of view and in dramatic narrative movies this may be a continuity mistake. For example, if the audience is seeing the antagonist from a vantage point and it is not the protagonist's Point Of View (POV) then it is confusing and inappropriate to move the camera particularly side to side because it would suggest the protagonist's POV. Further, as a stereographer, you do not have the right to move the camera unless you are directed to do so by the director. It is the director's creative responsibility to ask for camera movement. Being in tune with what the director wants to achieve is the focal point of the decision to create perspective shifting movements.

8. Limit the use of Gimmicks

Again, this is up to the director and sometimes the producers; if they want gratuitous 3D then we must achieve it in the best way possible. With experience they will become more understanding of real 3D moments. The fastest exit from the production is through the doorway labeled "Professor of 3D." Listen to the director and have a good rapport with the camera operator. Be a catalyst and not a critic during shooting. A stereographer is there to do the stereography as per directors blocking and plans. Convey your suggestions and qualify them by questions and answers with the director.

9. Be careful regarding "window edge violations" particular at the vertical edges

I will let Gary Isaacs DIT from New Jersey USA answer this: "Something has to be on the edge of the frame!"

See 2. Do not violate the edge of frame under Composition of 3D Shots.

10. Greater than normal depth of field is friendlier to 3D

See 4 Composition of 3D Shots: For a more immersive experience use a deep depth of field so that the audience feels like they are part of the action [giving the Audience Breaks].

11. Support your Stereo Depth Cues

Depth cues are, in any scene, a means of assessing and verifying binocular ranging. Stereographers try to align the lens in a given set up so that obvious depth cues are visible enough to assess their size and relative distance from the observer. Over time, this becomes an automatic consideration by experience when lining up even 2D shots to reinforce perspective.

12. Binocular Symmetries – The only difference between a stereo pair of images [movies] should be Horizontal parallax.

This is correct and important. Vertical, rotational and size alignments are key factors in creating good 3D. This tip points out the stark fact that binocular ranging is the only thing we have mechanical control over in stereography other than choice of lenses.

13. Scale the 3D Parallax, to the Final Size of the Movie or Display, "Computer or IMAX"?

This is only true in a very limited sense. There is generally proof that the audience in most cases position themselves where the best experience is once they know the mechanical limitations of the theater from Computer to IMAX. The scale of the screen determines the audience position. The generally accepted rule is that no matter what the target screen size is a parallax value of 5% of the horizontal sensor width has to, by default, be 5% of the screen width. 5% is considered the limits of sustained on screen parallax for the viewer in front row. This value can be momentarily violated to about 8% and it is better to record comfortable limits of 3-4 % as a **'close approach distance'** for any given screen.

The important point here is to urge the audience of small monitors and trade show screens to get within one to one and a half screen widths trying best to center themselves at the proper viewing scale of the screen rather than trying to shoot for a particular screen size. Many people attempt to

evaluate content on large monitors that is destined for D-cinema theaters by sitting at the scale position of standing in the lobby of D-cinema or the projection booth. Remember the 3D effect is directly proportional to where the audience positions them selves and the distance to the screen.

14. If toeing-in of the optical axis is used then the background at infinity must be limited.

This statement requires rewording because infinity cannot be limited; only avoided:

***If using convergence, the 'behind the screen' positive parallax value of any background must be limited to the closest audience-viewing angle*.**

There are formulas that must be studied and understood to do this properly. Depending on the Stereographers level of experience, it may be possible to evaluate onscreen positive (behind the screen) parallax on the fly.

The background (object) at infinity means it must have zero parallax or less than 1.5 degrees of positive parallax by the closest viewer. Unfortunately this is complicated to understand because the convergence point allowed at any distance varies with the lens focal length and interocular distance chosen and the seating distances. This is probably the hardest thing to understand in stereography. Fortunately for Stereographers, it keeps them working because giving a convergence and I/O capable device to anyone without hardcore experience in this regard can very quickly create the dreaded walleye unwatchable background particularly with zoom lenses.

With the advent of live broadcast, anyone with intimate knowledge of I/O and convergence drive will always be on set until complete mechanical and esthetic automation takes over.

If using any form of camera convergence (toe in, angulations or optical lens shift) the farthest background object must be at the positive parallax limit of P-value not exceeding 1.5 degrees of arc from any of the closest audience viewing angle.

15. Create I/O convergence values for the average distance in the Theatre Space [middle row going back]

ABSOLUTELY NOT! The front row is by far the most important consideration because this is where all the mistakes are most evident. In the front row, walleye will be the worst because excessive negative and positive parallax is most severe due to the high viewing angles being close to the screen. Think about the physical angles of the sight lines of person at back of theatre and at front. If you walk right up to the screen the parallax double image, with 3D glasses on, it is going to be really far apart and your eyes will need to cross severely to see it – same with person in front row. Now go to back of

theater and think about how small that angle is no problem for the couple in back row. That's why many people sit at the back of the theatre – it's easy to watch and the objects fly farther at you – or so it seems; but it's not really true geometrically because they actually have less parallax to deal with – only the fact they can relate to the theater space. The front row is where good peripheral vision exists and that is where the 3D immersion people go so pay careful attention to their experience; if you set limits for front row the rest of theater is going to do OK.

Composition of 3D Shots

Stereo is very Subjective: No two people process it exactly the same.

3D is WIDE / CLOSE / FLUID / OMNI-PRESENT with good depth of field.

This statement is critical for directors and producers to read. Consider that the criterion for making a 3D movie is just to make a movie and not a 3D movie. Forget that 3D has all these attributes; the attributes will manifest themselves in the process if done correctly. Try to avoid drawing attention to the method by striving to gratify every shot with good 3D. The more we agonize over how to make it more or less deep or of great depth of field, the closer to the danger of loosing the subtleties of cinematic story telling.

1. Think Deep – Look at each element in the frame and determine how it will play out.

The later part of this tip is a good idea. I would say look at each element of the frame and try to determine its visual weight and contribution to the statement being made. The stereo aspects should be subliminal and not so intent on depth. Think deep I suggest should be replaced by **"think normal"** or removed altogether because 3D is all about enhancing 2D cinema by introducing parallax that mimics real life within some limits.

2. Do not violate the edge of frame.

This is one of the most overstated and common rules, with the least importance. We live with and totally ignore the edges of our peripheral vision in normal life. The fact that we have the freedom to scan around the theater allows us to wander from the story and we discover that the image tends to collapse to the screen plane if the feet are cut off (easiest to notice) or if the subject is truncated at the waist or a light on the edge of the frame is cut in two. This is all true but if your mind is wandering enough to start evaluating this phenomenon while watching the movie, the movie must be very boring. It is much more important to create a balance of visual weight in the scene to keep the audience captivated and avoid wandering off the screen and discovering the non-stereo region.

Non stereo region: What is more important and largely ignored is the fact that the area at the edges of the frame contains non stereo (2D) information due to the over scanning of the left and right eye lenses respectively. Far more important than violating edge of frame, is a guideline created by drawing an inside box on every monitor that removes about 3 % of the frame width and corrects the 1.78:1 aspect ratio at the top and bottom of frame. This will produce far better results when blowing up the image to eliminate the non stereo region which is more disconcerting to watch than so called edge violations.

My advice: pay more attention to walleye limits if convergence is used, axial alignment and close approach distances and less attention to edge violations. Ask yourself what is the difference between a) rock face cascading down the edge of your frame embracing a centrally positioned horse and rider and b) looking (partially) over the shoulder of a man adoring a woman? Apart from being partial to the man or the woman and not the rock, there is no real esthetic difference between the two "edge violations." The edges of the frame are not always thin air. In fact, no edge violation scenes are almost impossible to create unless you are in outer space.

3. Vary the use of depth to allow the audience a rest period, from deep to more shallow.

To vary the use of depth suggests changing the focal length and therefore the suggestion is to change focal lengths to expand or compress the binocular ranging characteristics between wide-angle lenses and normal lenses or longer focal lengths. It is more likely that there is a presumption that we can vary the apparent depth of a scene by convergence or I/O spacing but the net result is always brain function striving for normal object size. In my humble opinion, the best way to give the audience a rest is to avoid excessive positive parallax driving the BG behind the screen. I believe this is what creates audience fatigue and eyestrain. Our natural vision comes to rest at infinity and we readily identify with the visual cues of perspective, image size, and parallax right out to at least 100 feet (30 meters).

Therefore, it is not really necessary to always create positive parallax by convergence to attempt to create screen plane depth when all objects will position themselves on the Z-axis by their respective parallax and vertical size. This can be tested and illustrated by shooting two identical scenes; one using convergence and the other only parallel lenses. Where convergence is useful and necessary is in set-ups where there is extremely close foreground subjects and primary subject center screen. Take a concert for instance; where we glide overheads in foreground and are focused on the performer mid ground. The subject (performer) ideally in this case, be slightly ahead of the convergence point and have small negative parallax. The people in the foreground must not exceed the close approach distance for the front row of the theater. The background of the scene can be positive parallax

(behind the screen) to the limit of walleye for the front row of the theater.

4. For a more immersive experience use a deep depth of field so that the audience feels like they are part of the action [giving the Audience Breaks].

This is very true and easy to say, however, it takes double the amount of light to increase the iris on a lens by only one stop. When you want to make a significant increase in depth of field it can double or quadruple the lighting budget and the manpower to do so. This is always a consideration of streamlined productions already spending 15% more on production to accommodate 3D.

5. Make sure that you review your material on the intended Target Size Screen to know how your images will scale up. If it is for TV it may not Scale up to IMAX etc.

Use the appropriate format size to match the subject to the theater. 3D Macro shots can very adequately be shot in HD and repurposed to IMAX or Large Format (LF) theaters. However, HD does not have the capacity to do large vistas and be repurposed to LF Theaters. Therefore, the scene size from Macro to Close-up, to Medium Shot, to Wide Establishing to horizon should always be matched to the image sensor capabilities.

Good contrast is ultimately better than resolution when considering scaling. This was proven by Carl Zeiss long time ago.

6. Avoid Divergence in your projected imagery. You cannot completely control where your audience will want to look in the FRAME. If they are looking in the BACKGROUND and the PROJECTED IMAGE is such that the PROJECTED POSITIVE PARALLAX is greater than the distance between their eyes [2.5 inches] they will have to rotate their eyes OUTWARD to fuse the left and right eye images. Since this is never required in the REAL WORLD, the experience can cause discomfort to the viewer.

The bottom line is that divergence in some cases, like wide I/O parallel camera setups, is unavoidable. Convergence related to this condition is necessary to prevent excessive negative parallax – too close to audience or closer than the 'close approach' distance. The divergence or so-called “Walleye” limit is accepted to be maximum 1.5 Degrees of arc from the front row viewer position (front row gets the worst deal). Therefore, when forced to use convergence use tables or software that shows the walleye limit depending on the focal Length of lens, near subject distance, background distance, and inter-axial spacing. This is the only way to avoid eyestrain and excessive divergence (positive parallax) that cannot be fused.

Summary of good 3D: The nearest subject of correct perceptive size and proximity is not too close to the limits of excessive foreground negative parallax, and the background is not in walleye condition of positive parallax. The rest is all about visual cues beyond our control or in the hands of set design or nature itself.

7. Pay attention to how the edit of your project will affect the audience. If you are quickly cutting between shots of different depths the viewer will likely experience EYE FATIGUE. This can be mitigated by adjusting the depth of the PRIMARY SUBJECT from shot to shot such that the viewer does not need to re-converge their eyes on every shot. It is always better to plan this in advance on how the sequence will play out.

The technique of 'pulling parallax' is common in computer animation and more prevalent in the advent of D-cinema projection where just before the cutting point the post-production expert will exponentially trim the parallax in the direction of the next shot. This can be done to the limits of excessive foreground parallax and the walleye limitations. It is exceedingly difficult and near impractical to suggest that the stereographer do this on set in camera. Most theatrical directors wait a good long time before yelling 'cut' when an actor's performance has ended to give the editor lots of breathing room to play with. To begin a parallax pull on camera would require a verbal queue from the editor – not the director- and is, by experience almost impossible to predict. Therefore, I suggest that the stereographer control the in camera parallax to mid normal range as best as possible and really forget about the possibility of doing a parallax pull at a cutting point. The reason being the parallax may be reduced or increased in reality and we can only bias to the middle road in live action capture. I have suggested the parallax pull idea many times and it is usually instantly dispensed with on set and never considered in documentary filmmaking.

More on the subject of "Stereo Depth"

Since 1980's IMAX 3D cinematographers have been using parallel optics and mirror rigs to shoot parallel 3D images with very little or almost no convergence what so ever. 90% of the time, 3D is about the natural perspective embodied in any scene ranging from a 3D macro image of a bug to an interior of a workshop to a dinosaur standing on the edge of a canyon. Subject size with proximity to camera, perspective, camera movement, and natural objects and their known scale to human size are 90% of 3D that exists in **2D Cinema**! The fantastic catalyst of 3D enhancement in theatre presentations is purely and simply from human binocular ranging. 3D introduces horizontal parallax into a 2D image and it unlocks all the essence of the visual cues. While using the simple method of parallel 3D capture there is very little we can control. This form of 3D is incredibly simple to achieve using a good mirror and careful, active control of inter axial spacing from 65 mm to less than 1 mm. What is truly disconcerting is the dichotomy between improperly executed on the fly convergence

following focus into eye strain and walleye that only a fish can fuse, and the simple, basic easy to control use of parallax pulling and the resulting 3D image it creates.

What is even more amazing is that one can shoot an entire movie – like most IMAX 3D movies, using mostly negative parallax and the audience always believes that infinity no matter what room or canyon is mapped out on the screen, infinity is BEHIND the screen and it is NOT. In fact, zero parallax is infinity and therefore no parallax and therefore the screen plane. So in most IMAX 3D movies, there is mostly negative parallax in any image and the viewer must believe that the images in the background are behind the screen because the parallax coupled with perspective, image size etc. is too overwhelming for the mind to accept. The huge benefit of all this is that there are no image distortions like vertical parallax, key stoning or walleye and if properly controlled no excessive parallax to give us headaches! It's just good 3D. Shooting parallel is always better for VFX work in post because the most difficult to deal with distortions are not imbedded in the original files.

8. Convergence is almost always set on the subject of greatest interest which follows the focus operation being hand in hand. If you Rack Focus during a shot than the Convergence should be Racked as well.

THIS IS POSSIBLY THE MOST INACCURATE AND CONTRADICTORY STATEMENT ONE CAN MAKE ABOUT STEREOGRAPHY.

When following this rule of "placing convergence on the subject", the subject is therefore at the screen plane and has no parallax what so ever. Racking focus and convergence together to the same image plane is possibly the most visually disruptive procedure I can imagine.

For example: If one had the convergence and focus positioned on a subject mid way in a large space, the subject would be at the screen plane and anything in front of it near to the camera would have negative parallax and be closer to the audience. If suddenly we rack focus and convergence to the foreground subject, the foreground would crash to the screen plane and all of the objects behind it would probably (depending on I/O and focal length) be **SEVERELY WALLEYED AND UNWATCHABLE!** It is obvious that conveying this rule to users of 3D equipment could compromise the entire production.

Parallax control, convergence and the tools related to stereoscopic space are NOT in any way related to focus. If they coincide, it is purely co-incidental. The aesthetics of parallax control have not yet been discussed. With experience, one can learn how to follow action and preserve the illusion of subject proximity changes when following action on the Z-axis. This procedure is not linear with the action and a whole study could be written on how to do this intuitively particularly when action is unplanned.

9. Interocular distance varies in direct proportion to the subject distance from the lens. The closer the subject is the closer the INTEROCULAR or INTER-AXIAL distance. The farther away to subject, the larger the interocular spacing between lenses.

The term "Inter-Ocular (interocular) and Inter-Axial distance applies only to the spacing between the Lenses or the distance between the image planes, film apertures or image sensors. Normally the lenses and apertures are the same value like 65 mm – the average of human eye. The proportions of a subject's distance to lens (two lenses in 3D) are most commonly termed PARALLAX. The horizontal distance between corresponding image points on stereo aperture pairs is called parallax. This is the actual physical separation value of subjects between the left and right eye images on the image plane and on the resulting screen plane. This separation is what creates the ability for the audience to use binocular ranging to perceive the proximity of a virtual subject in the theatre (apparent distance). Changing the interocular spacing only changes the subject's apparent distance and the resulting vertical size of the subject by moving it closer or further from the audience. Using reduced interocular distances in mirror setups can create necessary reduction of screen parallax when shooting close ups with tighter focal lengths where subjects are too close for 65 mm and a lens horizontal field of view of the human eye.

10. Interocular and Convergence should vary dynamically throughout the Movie.

THIS COULD POSSIBLY BE THE SECOND MOST CONTRADICTORY STATEMENT TO CONVEY TO USERS OF STEREO IMAGE RECORDING DEVICES.

It is fundamentally important to:

Limit the use of convergence unless forced to use due to excessive I/O limitations of camera equipment OR you are shooting exclusively for a computer monitor or small corporate screens where the audience can see and relate to the small size of the screen. Convergence has very little net effect on large D-cinema and Large format theater screens. When using longer focal length lenses on mirror rigs you must reduce the I/O spacing to correct the screen parallax to normal proportions. The only way to do this with a side by side rig is to use convergence within the limits of positive parallax.

Vary the Interocular spacing to control the apparent distance to the foreground subjects and normalize the subject size. Use convergence if possible, where there are extreme limits of foreground activity connected visually with distant backgrounds. Keep the background in a tolerable positive parallax condition and foreground in check with comfortable negative parallax.

The only way on camera, to follow negative and positive parallax plus a convergence point in the image, by watching a monitor, is WITHOUT GLASSES ON and comparing parallax with either anaglyph or 50/50 split 3D. The reason it is not advisable to use 3D glasses to pull parallax and convergence is simply because your mind and eyes will always be struggling to bring you back to normal. You will only see a mistake in judgment well after it is already too late!

Details:

a) When possible shoot parallel optics for negative parallax values (in front of screen) that are conducive to the average humans' ability to use comfortable binocular ranging. That means to prevent the closest apparent subject size at any given moment from exceeding closer than 4 to 3 feet (absolute minimum) from the viewer in the front row of most conventional theaters.

b) Limit positive parallax (divergence 'behind the screen') to the limits of average human capabilities sitting in the Front Row.

c) Avoid "miniaturization" (Lilliputian, Gulliver effect etc.) by increasing I/O unless of course it is being used creatively to make a statement.

d) Attempt to place the subject as close as possible to the ortho-stereo position of mid theater.

Rules for the Road

Do's

1. Challenge everything you were told about in 3D. We are inventing New Art Form and Grammar. Stop thinking the World is Flat.

Filmmakers have been making excellent 3D movies in 2D since the dawn of motion picture. True stereoscopic cinema is just a machine that adds the catalyst to unlock the fantasies of our real vision inside a theater.

There is nothing new in 3D since the invention of stereoscopic flip cards in the late 1800's. It's all about binocular ranging. Over time, we have developed and learned to use new technologies and tools developed that improve the quality of 3D cinema capture and presentation.

2. Check visually your work in 3 D on the large 3 D Monitor.

The important note is: position your eyes at the proper scale of the target theater FRONT ROW. Without doing this it is impossible to evaluate an image even on a large monitor. Most of the time people watch large monitors from positions that are, to theater scale, outside in the parking lot.

3. THINK 3D

Pretend you are making a 2D movie and want to make it look 3D.

4. Go see every Movie you can in 3D Build your Stereo Culture, Go to Museums, Art Galleries etc. Look at 2D Depth Cues and how they apply.

Read the power point presentation by Hugh Murray Physicist and VP of Imax, 1995 presentation to the GCSA on 3D. It is one of the most authoritative studies of Stereoscopic cinema.

Don'ts

1. Don't forget your Stereo Depth Cues.

Don't forget to assess and verify binocular ranging when filming in 3D.

2. Don't make the 3D Movie if the Story is bad.

It is a fact that a large percentage of the global motion picture market is either never released, break even, or never recoup the investment at the box office. In my opinion, it is truly impossible to determine the success of a script, synopsis, or treatment. Even the most abstract of all categories can produce box office cult following or successful character development and huge box office receipts. The point is: Leave the story telling to the director and keep your personal opinion from influencing the stereoscopy.

Get as much practice and experience as you can!

3. Don't think "we will fix it in POST" Stereo mistakes cannot be fixed easily in POST

I very much agree and inside the industry there is a need for producers to be aware that post production should be more in touch with the stereographer while repurposing content as per the Edit Decision List. Rarely does a stereographer have the luxury of guiding the control that post production has over the imagery that was created on camera. It is possible in post to create severe eyestrain by pulling parallax in any direction and imbedding this error in the digital files while watching a 32-inch monitor and expecting the result to be accommodating the front row of a large D-cinema theater. Only real theater testing at front row can determine how a particular shot or action will work. Hence my poke at our most highly respected colleagues in post production houses:

Definition of Stereographer:

One who records distorted, confusing and totally unwatchable stereographic images that are then transformed into an amazingly comfortable and dynamic 3D cinema experience, in post-production. William Reeve csc

4. DO NOT HARM - Poking Eyes is as much fun as crushing Ears and a Headache is NOT a Valued Entertainment Asset.

I do not disagree, however, I would say that a stereographer can and will be asked to make extreme

cinema violent head banging content for target audience that wants to be abused. A good stereographer can allow this to happen in 3D so that the audience can feel the emotional pain without the eye strain. It is very simple to do once you know how to control stereoscopic tools and keep the human eye comfort level in check.

4. Don't hurt your audience with bad 3D!

Be aware of the visual impact of 3D. Approaching 3D as exaggerated movements or gimmicks can hurt the audience's eyes or become tedious or predictable. A good example of 3D gimmickry is the process of repurposing 2D motion picture to 3D. Productions looking for quick profits by riding on the wave of 3D, are introducing fast tracked pseudo 3D movies generated from 2D image capture in original photography. Only the extreme high end and most labor intensive versions of this process can come anywhere close to contour and texture mapping, stereo information, and proportional parallax imbedded in true stereoscopic original recording. The process falls apart when low end computer interpolated 2D is quickly rendered, due to extreme budget limitations that result in fake and unrealistic 3D. Most audiences recognize this gimmick very quickly as it degrades the experience and the reputation of the 3D content providers.

Summary

In summary, I suggest that anyone seriously studying stereoscopy should begin with the physics and geometric relationships between the camera space and theater space before entering into the realm of esthetic control of the tools at hand.

I welcome any comments and critique of what is written.

Good luck!

THINK GOOD 2D AND IT WILL BE GREAT 3D!

William Reeve csc