3D Basics *Provided by Technica 3D*

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Section 1 - INFORMATION STAGE
Brief History

In 1584, a successful Italian painter wrote;
"A painting, though conducted with the greatest art, and finished to the last perfection, both with regard to its contours, its lights, its shadows, and its colors, can never show a relief equal to that of the natural objects unless these be viewed at a distance and with a single eye."
-Trattata della Pictura, Sculptura

Mr. Leonardo da Vinci, though widely respected for his conceptual and artistic contributions to vision sense understanding, as a master painter, he was referring to what was heretofore a 2 Dimensional Media form. To their credit, Mr. da Vinci and the other painters of the Renaissance period were the first to recognize the merits of monocular depth cues in their works and for the first time in art history a sense of the third dimension began to emerge in visual media. Their rules with regard to rectilinear perspective changed both the art world of the time and began peoples quest to see in their art the full scope of our visual ability.

Stereopsis (aka horizontal disparity, retinal disparity or binocular disparity)

Stereopsis or "Depth Sense" was formally discovered by Sir Charles Wheatstone, a British Scientist in the early 19th Century (he also invented the English Concertina, Playfair Cipher (early encryption technique), and improvements to the "The Wheatstone Bridge", an early method of measuring an unknown electrical resistance. All concepts that were very advanced for their time.

Stereoscopic concepts are the base of a more sophisticated technique called stereophotogammetry, a major component of cartography, architecture, manufacturing, police investigation, astrology, archaeology, meteorology, military applications and many facets of engineering.

Two points of reference with respect to any subject is the key to depth perception and the brains ability to process those two points of reference back into a single albeit central image is what Stereopsis or Depth Sense is all about.

The first paper on the subject of Stereophotography was published in late 1830‘s, at almost the same time that Sir John Herschel first coined the term "Photography" in 1839, (derived from the Greek words for Light and Writing), and a scant decade after the first successful photographic image was produced in June/July of 1827 by Niepce, using material that hardened on exposure to light and using an exposure time of 8 hours. Niepce

later teamed up with Louis Daguerre (Niepce died 4 years later). Daguerre continued to experiment and soon discovered a way of developing photographic plates and cutting the exposure time from 8 hours down to 30 minutes. He also found that the images could be made permanent by immersing them in Salt.

All this illustrates that interest in 3-D imaging,though conceptually introduced by the Renaissance artists of the late 16th century, technically has been around as long as the photographic process itself.

At the London exhibition of 1851, Queen Victoria, amused by various stereo views was later presented with a stereoscope of her own. Media of the time took hold of this and much ado was made, causing half a million of the devices to be sold in the next five years.

By the mid 1850's parlor Stereoscopes had emerged as a popular element of entertainment and education among the wealthy classes throughout the world.

Concepts of Binocular vision seem very obvious now in hindsight, but before Wheatstone, there was no clear written understanding that two slightly dissimilar left and right images could be combined by the brain to form a single image with a new depth sense, or 3rd Dimension.

This forms the concept of 3-D Stereocinematography.
******Diagram to Illustrate*****

Major Achievements in 3-D
- 3-D Image presentation has had a long and varied history since its early beginnings

- Since it burst onto the elite scene in the mid 1800‘s it has ridden a popularity roller coaster as it has been presented in many different forms and in wide variety of qualities.

- Introduced in 1939 at the New York World's Fair was the venerable Viewmaster. Designed originally as an alternative to the scenic postcard, it again ignited the publics interest in seeing images in more then just two dimensions. The Viewmaster was more then just a children's toy, The US military purchased 100,000 of these stereoscopic viewers to use for personnel training and for airplane/ship identification and range estimations. A 25 volume atlas of human anatomy was also produced for use with this device... Subjects and uses ranged widely and Viewmaster changed with the times. Since its inception over 70 years ago there have been over 25 different models of the Viewmaster produced and over 1.5 billion viewing disks created.

- 3-D Cinema has been around as early as 1915 with the first known presentation of "Jim the Penman" which had some early crude anaglyphic segments

- Anaglyph images provide a stereoscopic effect when viewed through two color glasses (each lens chromatically opposite currently red and cyan, red and blue were used in B+W past primarily due to cheaper material costs)

- The first known feature length presentation in 3-D was "The Power of Love" which Premiered September 27th 1922 at the Ambassador Hotel theatre using the two camera, two projector Fairhall-Elder stereoscopic process developed by Harry K Fairhall and Robert F Elder.

- Two months later on December 27th 1922 an elongated short film called "The Man From Mars" (aka M.A.R.S. or Radio-Mania) was released using the "Single Strip Eclipse" stereoscopic process (Eclipsing shutter viewers)

- Eclipsing shutter viewers incorporate glasses which isolate each eye to see alternating frames.... these were a complicated mechanical apparatus which has since been much simplified using Liquid Chrystal shuttering with advanced wireless triggering systems

- Throughout its history in Cinema, 3-D has seen much technical experimentation come and go, from innovative individuals to opportunistic Movie Studio, from Military training applications to a national 3-D cinema program operated by the Russian Government. Anaglyphic and Polarized-Light systems being the one most suitable for widely used for cinematic presentation today

- To date there have been 300+ 3D cinematic releases since its early and auspicious beginnings, with the 1950's and 1980's being the most prolific era's for 3D cinema production.

- A fairly complete list of 3D Movie Releases can be found at www.3dmovielist.com

3D Stigma Attached and Why

- By and large 3D Cinema Stereoscopy was badly abused and audiences eager for this novel approach were subjected to mediocre to poor presentations whether technically or creatively

- They quickly tired and began to foster a negative view

- As a result 3D Cinema as a presentation concept became cheapened and faded from mainstream theatre, and quickly became crutch for the B Movie Producer

- To be honest,.... early 3D technically was a difficult and obtrusive invasion into the production procedure

- In the past there really wasn't a simple and singularly accepted means of conveying two images onto the same screen and most theaters were not equipped to do it

- The technical challenges of marrying two strips of film to create an anaglyph or polarized image proved costly and with to few theaters to present in, it limited the audience and therefore the appeal of 3D

New World for 3-D and Why is it Different

- As a result 3D cinematic presentation's popularity has ebbed and flowed throughout its nearly 90 year growth period but with the recent and widespread acceptance of Video and more specifically High Definition Video as an means of Professional Photography the process of Stereoscopic Image Capture has taken many leaps forward technically and has begun to enjoy a new resurgence as a prominent Cinematic presentation form.

- Gone are the expensive, troublesome, and cumbersome technical issues of the past

- Today 3D images of great quality can be realized with a minimal degree of technical obtrusiveness

- In North America there are approx. 4000 Theater Screens currently outfitted and able to present in 3D with more being added every day.

- Jeffrey Katzenberg has predicted that in time for the release of "Shrek Goes Forth" in the summer of 2010 there will be 7500 3-D ready Digital Cinema Screens (* Hollywood Reporter Dec 1 2008)

- Dreamworks Film release,"Bolt" realized 50% of the shows Cinema ticket returns from 3-D theaters despite the fact that 3-D screens only made up 30% of its release (*)

- Premium ticket charges at 3-D venues fueled an average 5.5% increase in the nation's ticket prices. This summer (2009) a total of 570 million tickets were sold, 1.5% fewer tickets then the previous summer yet with the 3-D premium added to so many tickets the total theatrical haul increased by approx. $150,000,000.00

- In its many forms (RealD, Dolby 3D, Imax 3D, Disney Digital 3D, etc) 3D represents the Movie Producing Studios attempt to lure audiences back into the theaters and away from the burgeoning home DVD/ Broadcast Movie Market

- In a short matter of time 3-D Stereoscopy has gone from the relative bottom shelf of the Cinematic toolbox to what is widely expected to be and according to Jeffery Katzenbrg of Dreamworks "an economic game changer for movie theaters"

- "Avatar" is quickly approaching the highest grossing movie of all time status with over 70% of its ticket revenues coming from 3-D equipped Cinemas

- The studios proprietary hold on this lure has a limited life span though as technology is emerging in the field of reliable and purchasable 3-D monitors of various sizes and qualities and the eventual advent of widespread 3D Broadcast Television and 3D Video Distribution

Why Element Technica

- In this new world of 3-D production there have emerged several pretender to the 3-D throne

- Introduced in April of 2009 at NAB was Element Technica's entry into the rapidly growing 3-D market (Check Fact)

- Element Technica, a company which emerged out of SL Cine, is a quality milling and manufacturing company which specializes in design and implementation of precision machined accessories for the motion picture and video market.

- Recently much success has been found by developing accessories for the Red One Camera users. By identifying the needs of this ever growing group and designing innovative and creative supplemental equipment Element has become the primary supplier of accessories to this market

- Element Technica Founders Stephen Pizzo and Hector Ortega, in 2007 recognized an industry trending towards 3D and began to investigate the feasibility of creating and manufacturing a precision piece of equipment that would allow filmmakers of any budget and resource range to achieve the same quality of 3D image at a less prohibitive cost and through a much more simplified process then was currently available.

- In the two years of development Element Technica's engineers have explored various mechanical and electronic design challenges. All avenues of 3D history and precedence have been explored and great expense has been invested to produce what we are here today to discuss and explore.

- Another option for the 3D Filmmaker Element Technica's.....

"Quasar"

Section 2 - INTRODUCTION TO "QUASAR"
WHAT IS QUASAR?

- Technica's Quasar rig, from the conceptual stage was designed to be used in a manner similar to a 2-D camera by the same 2-D camera crew with a minimal amount of advanced training

- Its outward simplicity is matched by some complicated feats of engineering that result is a shooting platform that can be erected and operated without the need to bring in "specialist" camera assistants or expensive "3-D experts" just to put it together

- Quasar operates on the principle of one mobile camera and one fixed camera

- The mobile camera operates horizontally and shoots through a partially front silvered 50/50 mirror mounted at 45 degrees

- The fixed camera operates vertically and shoots a reflected image off of the same 45 degree mirrored surface (this fixed camera is adjustable for alignment purposes but

remains locked while shooting)

- Back in the beginning of the day we defined Stereopis as a horizontal disparity between two viewing elements. Whether eyes or photographic lenses H.D. is one of two principle ingredients that make up all stereo depth perception.

- For the purpose of 3-D cinematography the afore mentioned Horizontal Disparity is know by three different terms:

1. Inter-ocular Distance 2. Inter-Axial Distance 3. Inter-Pupulary Distance

- By and large, each essentially refers to the same thing and supposed experts will argue the technical correctness of each but in general the accepted standard is:

INTER-OCULAR DISTANCE

- This "I/O" is the measured horizontal shift from "0" with respect to the fixed camera

*****Diagram to Illustrate*****

Motion Plate

- On the Quasar, this I/O is managed by the horizontal camera by way of a positive drive, manual or motor driven assembly called the "Motion Plate"

- The frame for Quasar's motion plate is machined from a single piece of xxxxx grade aluminum.

- As an integral skeletal element (supporting the whole upper assembly) as well as the complete drive assembly for the rig, this Motion plate presented the engineers with some formidable challenges

- Designed to work either underslung (as in the beamsplitter mode) or upright (as in the parallel mode) it is imperative that all movement in this plate is directly and purposely connected to the two drive screws. Due to the precision nature of 3-D photography and so that the rig can operate successfully in a wide range of shooting environments all extraneous motion had to be eliminated while keeping the intended movement smooth and fluid

- In the case of the beamsplitter set-up the Horizontal camera would be top mounted and hung from the inverted Motion Plate

- The Dovetail is connected to the Motion Plate via two 3/8th" drive bolts

- This connection of the dovetail is semi-permanent as a precise amount of torque is applied to ensure the correct resistance is placed on the teflon pads which help to stabilize the plate

- Driving the dovetail is done by two parallel drive screws which can be either manually or motor driven

- When the screws are turned at the same rate the Dovetail will move laterally and parallel relative to the fixed camera

- When the screws are turned singularly or at a differing rate then a factor know as "Vergence" is introduced (the other prime ingredient in depth perception)

- For 3-D imaging we need an element known as Convergence that is by definition "the degree or point at which lines, objects, or concepts come together so as to form a single product".

- For our purpose, Convergence can only occur by toeing in one of the cameras to a intentionally determined intersection point and on Quasar this is done in the motion plate

****** Diagram to Illustrate ***** - In order to manage both I/O and convergence it is necessary to have a starting point in which both cameras are perfectly aligned. From this point creative decisions can be made in a measured and repeatable way.

- Perfect alignment is much easier to say then it is to achieve, though Quasar has built in adjustments that make it relatively simple to dial in this alignment and to check alignment mid work stream

Alignment Module

- The task of alignment conforming falls to the vertical camera which is mounted on what is aptly named "The Alignment Module"

- Supported on single piece supports we call Shark Fins is a three axis alignment plate complete with four independent friction locks to fix the positions once alignment has been achieved

- In a perfect world we could simply place the cameras on surfaces at 90 degrees to one another and a mirror placed at 45 degrees should allow you to align the images by zeroing the I/O....., but,..... given that optical centers of most lenses are not matched, given that lens mounts vary, given that the machining of the camera bodies may not be exact,...there are several other variables that can obstruct perfect alignment so there is a need to be able to adjust one of the cameras to overcome these deficiencies.

- Quasar's Alignment Module has direct micro adjustment capabilities over three axes designed to overcome these alignment obstacles

- Z-axis -Tilt-axis - Roll-axis

- Each of these individually or in tandem will allow you to precisely fine tune your

alignment so that items both close and far will have no vertical shift and a 0 I/O

- Once alignment is tuned then the four independent friction locks are engaged and the plate is locked to the rig and will allow no further movement from this camera

- With this as a starting point you can then make controlled and creative decisions regarding the implementation of 3-D into your shot(s) design

Mirror Frame

- The one and only mirror angle that will allow for camera alignment is 45 degrees

- The mirror frame was designed to allow for small scale adjustability to the mirror along with the ability to lock it in a rigid and fixed position

- In theory this adjustment should not be necessary as once the mirror is set and locked it should not move and the relative angle should be maintained. Given that the rig can be used in a variety of shooting environments and temperature ranges, this adjustment capability will allow you to bring it back into its intended position should it stray.

- for alignment purposes the mirror should be maintained at precisely 45 degrees even a little variation from this angle will cause difficulty in maintaining camera alignment in both near and distant range

- It is advisable to have an electronic protractor available to check its relative position periodically and make adjustments. Even one degree off will make total alignment frustrating.

- The Mirror Frame on which the mirror sits is dampened with vibration isolating material to help absorb both direct shock to the mirror and also to limit transmission of any vibrations which could be visible in shot

- The actual frame is machined out of a single piece of aluminum to provide a base with no flex

- Positional adjustments are made to the mirror frame via a nodal pivot by fore and aft adjustment screws. Each side adjusts and locks independently. Access to the adjustment screws and locks is maintained at all times

- The Mirror Frame assembly is attached to the rig by two 1" Carbon Fiber Tubes. The carbon Fiber provides extreme solidity with low mass. The carbon fiber has a low resonance transmission value which assists in isolating any vibrations away from the mirror

- The Mirror itself is a 17.25" x 9.2" x 3/8"(158.7 sq in.) partially front silvered mirror. The Silvering is set to allow 50% of illumination to pass through while the remaining 50% is diverted. Both transmitted and reflected light remains color neutral, and non

polarized and is only decreased in intensity by one stop to each camera.

- The Standard Mirror is suitable for most lens focal lengths used in 3-D shooting situations though it is not without limitations. If the need is for lenses in the Telephoto range to be used then a premium glass would be recommended. This expensive and fragile piece of highly polished and precision engineered glass has reflective tolerances much finer then the standard mirror. This requires the use of a special mirror frame and the advance purchase of two precision mirrors as lead time on this glass is many weeks

Mirror Box

- The Mirror box is a sturdy but lightweight 5 sided box which protects the mirror from damage, dirt, and unwanted illumination.

- It is black (for obvious reasons) and has a black velvet insert which sits on the base of the box to further deaden any reflections which could potentially bounce up and be seen by the horizontal camera

- The Box supports a full four sided set of eyebrows which further assist in limiting the light which hits the mirror

- These Eyebrow elements are mounted to the outer surface of the Mirror Box (each side a separate piece) which makes each one fully adjustable independent of the other sides

- To accommodate light containment through the movement of the horizontal camera are a set of carbon fibre sliding baffles are employed. Each baffle element is lined with Teflon tape to allow the parts to move smoothly with the lens to maintain the light limiting integrity of the box while allowing the in-shot I/O adjustments without suffering from light leaks or jams

- It should be noted that although the mirror box is a tempting lifting point, it does house one of the key ingredients to camera alignment and also one the the most fragile elements of the Quasar Rig so are care should be taken that box itself is not used to lift or support the rig in any way

- Side ports on the box's sides allow access to the underside of the mirror and the bottom of the box for cleaning

- If for any reason the mirror frame needs to be removed from the box, this is simply done by loosening 2 bolts and the mirror Frame and box assembly slides out and two more bolts removes the Mirror Frame from the Box

Hand Control

- The Quasar hand controller is precision machined for both balance and ergonomics

- It weighs xx lbs (with Battery) and incorporates three independent controls over two channels

- The hand controller communicates either wirelessly through a Blue Tooth connection with a range of +/- 300 FT or wired through a dedicated four pin cable. It can easily be switched between communication modes and operates the same in each

- I/O is controlled either with a scalable slide control or a markable dial configuration. The travel range can be broadened or limited from shot to shot with a simple and quick three step process

- Convergence is controlled by a large side mounted dial with a wide marking ring which makes scaling and marking very easy. Again the travel range can be broadened or limited very simply and quickly by the same process as I/O control

- The whole unit is powered externally by a standard Sony NP-FM50, 7.2 volt battery which has a quick charge cycle and are readily available at any photography or electronics store.

Other Elements that make up the Rig

- Above is the basic rig but as with all camera equipment setups the basic rig will not work efficiently without the use of some accessories

- The following are some necessities that will make the Quasar more user friendly:

Monitors and Arms for each camera
- To Monitor the image generated by each camera

3-D Monitor (TransVideo Cinemonitor 6) with Mounting Arm
- To Monitor Alignment

AJA Gen 10 HD/SD Sync Generator
- Generate sync pulse to lock cameras together

Element Technica's Power Distribution Box
- To distribute all 12 and 24 volt camera and accessory power

Lens control System
- Preston, C-Motion or Arri Lens control systems set up for 3-D

O'Connor EX 120 Head
- Most advanced head to carry the top heavy load

- Geared Heads not recommended due to possibility of load loss

Elements V-Dock Mounting accessories for 19mm Rods
- at least three for Distro-box, Lens control Mod, AJA Box

Section 5 - 3-D Pitfalls and Procedures
- 3-D image capture should not be as intimidating as it may seem no matter what perspective you have on the matter whether you are a Producer, Director, Designer, Actor, D.P., Operator, or Camera Assistant.

From the Producers Perspective;
- It will require two or more camera staffing positions
- It will require a little more time per setup (though as people get more comfortable this will become minimal)

- A slight increase in equipment and post costs
- Will have to learn the language of 3-D

From the Directors Perspective
- Time expense (but less coverage)
- Will face plethora of new design decisions
- Will have to liaise with a trusted Stereographer
- Will have to learn the language of 3-D

From the Production Designers Perspective
- New challenges will be presented as Depth becomes a more prominent element of set design
- Will have to learn the language of 3-D

From the Actors Perspective
- Nothing will really change but new opportunities will emerge

From the Director of Photography's Perspective
- Minimal changes to lighting design
• Will have to liaise with a trusted Stereographer
- Will share in the new design decisions as they relate to shot design
- Will have to learn the language of 3-D

From the Camera Operators Perspective
- Challenges as they relate to bulkier equipment
- Will share in the new design decisions as they relate to shot design
- Will have to liaise with the Stereographer
• Will also have to learn the language to 3-D

From the Camera Assistants Perspective
- Will have to become familiar with new equipment and procedures
- Will have to work with a Rig Tech and Convergence puller
- Will have to liaise with the Stereographer
- Will have to develop new methods to streamline the preparatory procedures to minimize downtime
- Will have to learn the language of 3-D

- In truth virtually all of the people on set will have to learn the language of 3-D to some level, obviously some more fluently then others.

- As a language it represents a wonderful new opportunity to communicate visual ideas through a greatly enhanced sensory experience.

- its language is strangely familiar as its roots are deeply set in Photographic history, yet it will challenge filmmakers to use it responsibly and artistically and with restraint. With its ability to leave an audience awestruck and amazed it also has the ability to leave them wincing in pain and vomiting in the aisles.

The Language of 3-D

- We've already gone over what I/O and what Convergence are now here is a little more information on what they do and how it relates to 3-D image capture

- First Convergence doesn't exist without a positive or negative I/O (you can't look at yourself) and I/O on its own, in theory, doesn't give you a depth sense image (forsaking all other depth sense cues for the moment). But with I/O and Convergence together you begin to see a photographic phenomena call Parallax. (Parallax, derived from the Greek word (parallelaxis) which means alteration)

- Given that we now have a measured Horizontal Disparity (I/O) and a degree of Convergence we have determined a Convergence Point. The Point at which the optical centers of each lens cross. The Convergence Point is a point on a Convergence Plane which runs perpendicular to an average of the two len's optical center lines (use parallel rig example).

- Now Choose a point equal distance in front of the Convergence Plane and one behind the Convergence Plane. The point in front of the Convergence Plane is said to be in a Negative Parallax Position and the point to the rear of the Convergence Plane is said to be in a Positive Parallax Position.

- Items in the Collective Frame of both cameras and in a Negative Parallax position will appear, when projected to be in front of the viewing screen and items with a Positive Parallax position will appear to be behind the viewing screen or in what is called Screen Space.

- Simply put this is the basic concept of 3-D image capture. Not to suggest though that this is all there is to know

- As much as Convergence is the necessary ingredient in 3-D imaging there is an other side to the story. Convergence has a mirror image twin called Divergence which if left uncheck can be the cause of physical pain and nausea in your viewing audience.

- Where you have convergence you also have divergence, which occurs to everything

beyond the Convergence Plane. When the divergence becomes to much (and here is why it is important that you shoot for your screen size) your viewers brains will rebel and an unpleasant sense of pain or nausea will ensue.

- Divergence can be forecasted and controlled by an adept Stereographer with the selection of a suitable I/O and convergence for each and every application.

Parallel vs Beamsplitter

- In 3-D there are a multitude of equipment choices to make in putting together a production's camera package. Lens's must be matched to each other, and then matched to camera bodies, camera bodies must be matched to Rigs and then Rigs must be matched to adequately trained individual so that they remain an efficient production tool.

- One of the most common questions asked is why not shoot parallel and avoid the use of a mirror?

- Firstly, Quasar can be modified to work both as a beamsplitter rig and a parallel rig and there are shooting applications where it is preferable or even imperative for it to be one or the other.

- The main reason to have a beamsplitter rig is for the reason mentioned above, Divergence, when objects of interest are relatively close to the shooting position and at the same time items of interest are set relatively deep, a narrow I/O will keep control of the background divergence and viewing brains will be able to resolve the image. In the case of a parallel rig, attaining a 1/4 inch I/O would be impossible due to the physical structure if the lenses and camera bodies. The beamsplitter rig allows you to have a 0 value I/O or any value up to 4 1/2 inches.

- Now consider the human eyes, we all have on average an I/O (or more correctly an I/P) of, on average 2 1/2 inches or so. Our depth sense is very good with items of focus from approximately 10 inches to 200 yards. Beyond 200 yards we rely on other depth sense cues which are not reliant on stereo vision to understand depth positioning.

Cues such as:

- Perspective, the notion that things diminish in size as they recede
- Interposition or overlapping, a closer object will occlude one from seeing a more distant one
- Aerial perspective, hazing or atmospheric conditions are compounded with distance
- Light and shade, a single source falls differently as items recede
- Textural gradient, leaves of a tree blend at distance yet are discernible at close range
- Motion parallax, close items move faster then distant ones when viewed from a moving position
- Degrees of focus, in conjunction with perspective if items are both foreground and background

- These 7 cues are present in both monocular or binocular vision. 2-D photography uses

them solely as means of identifying depth. 3-D incorporates these cues, as well as the capability of spreading the I/O beyond the ability of the human vision system to give a true depth sense to items beyond the 200 yard mark.

- For this purpose an I/O beyond the range of a beam-splitter rig would be necessary and thus the need for a beamsplitter rig (3-D astral photography can use I/O values of several miles.)

- Some remote heads are more spatially suited to the dimensions of a Parallel rig vs. a Beamsplitter (helicopter), as well as its decreased weight

-Given that the change-over time from one "mode" to the other is not something you want to have a crew standing around waiting for it is best to determine the needs of the shots well in advance so the rig can be configured beforehand.

3-D Post Production

- In 3-D image capturing, some of the greatest tools that you have at your disposal are to be found in the post production world.

- Even though care and consideration is given to all aspects of the photography there can always be some issues which creep into the pictures which were heretofore unseen.

- In post production there are tools to make many corrections such as:
- Ghost-busting - the removal of aspects which are not common to both left and right eye images (i.e. flares, highlights, reflections)
• Alignment issues - can correct for camera misalignment (at the cost of some resolution)
• I/O adjustments - (resolution loss)
• Color adjustments - to match color between images
• Density adjustments - to match exposure between images

- These tools and others are improving every day but even with these tools in hand care should be taken to understand and implement properly the concepts of 3-D Photography so as to minimize the post costs in terms of time, expense and also resolution.

The Ideals of 3-D

- In the process of 3-D photography and especially for motion picture 3-D image capture there are some pitfalls to avoid, some guidelines to adhere to and for the avant guard among us, some rules to purposely break.

- Firstly, keep your scene within the "Box"..... As with 2-D projection or even broadcast there is a screen left, a screen right, a top and a bottom. The dimensionality of your screen has limits and those limits should be maintained in the 3-D world. The space in front of and behind your projecting screen is free space but for all intents and purposes keep your images in the screen space.

- Secondly, beware of 3-D jump cuts. As with 2-D storytelling shot selection and design

are a major part of 3-D movie making. In fact complimentary shot sequence planning is even more important when you add the third dimension.

- Each 3-D image gives the viewer so much more to look at and appreciate that well designed shots will hold the viewers interest much longer and your audiences brains far less fatigued by the effort involved in consummating the left eye / right eye image in a rapid fire pattern.

- As discussed before limiting background Divergence is also key to the comfort of your viewing audience. Respect the limitations of the brain to "put it together" and design shots within these limitations. Approximately 10% of the general public is Stereo blind for a variety of reasons and there are many more who struggle with Binocular vision so in the interest of having them stay to the end of the show..... shoot accordingly.

- High key lighting could cause ghosting or other left or right image disparities.

- Unjustified lighting will also become more apparent due to a greater sense of the 3rd dimension.

- A competent Stereographer will be the guardian of such responsibilities. He or she will work Directly with the Director, DP, Operator and Assistants to ensure that all of the images will cut seamlessly where intended and that the above mentioned ideals are somewhat adhered to. Like I said, some rules are meant to be broken but you do so at your own and your audiences risk.

- As 3-D production becomes more and more commonplace it necessitates a new addition to the minimum crew requirements specifically on productions where 3-D is being implemented. This is the position of the "Convergence Puller". This person will be responsible for measuring, marking, and pulling of the convergence which on first glance sound very simple but remember that convergence is directly tied to the I/O so change the I/O and a whole new set of Convergence marks come into play. This person will work very closely with the stereographer and will need a more complete knowledge of the 3-D process. Often the convergence puller can also act as set tech for his particular rig but these responsibilities need to be discussed in advance.

- One of the questions most asked by people who come in for a Demo is "HOW IS SHOOTING 3-D GOING TO BE DIFFERENT THEN 2-D". Well the answer to this is not so straight forward. As many of you know, each show is it's own animal and some people take to new technology better then others. Although 3-D is not new, in its current form the technology and some of the processes are and to most people who are keen to embrace it, it will be new to them. To be clear, there are some elements of the 3-D process which will be time consuming and at times frustrating. As people become more accustom to the process and as technicians become more adept at managing the rigs this "3-D" time will diminish and the benefits that come from enhanced depth in your images will shine through. Even the most mundane of images look exponentially better in 3-D so

imagine how it can be refined and used in your own work. Imagine it and then make it happen.

Section 5 - Wrap Up
- So that about wraps up our time here with the Quasar

- We at Element Technica always welcome input and questions from our users worldwide and are always only an email away should anything come up.

- If anyone wants to delve further into the technical side of 3-D shooting, 3-D history, or more info on the ideals involved in 3-D image capture,.... there is a rather technical piece of literature available which is:
" Foundations of the Stereoscopic Cinema - A study in Depth"
by Lenny Lipton Van Nostrand Reinhold Company
Copyright 1982
- This is somewhat of a slow read with the accent on "Techinical". Mr Lipton goes into great depth in his explanation and also in his own personal experimentation. He was writing from a pre-video world perspective so some of the issues and points that he raises no longer are applicable but to date there is no other writing that more adequately breaks down the unique challenges of 3-D Photography as does Mr. Lipton's book.

- For more information about Element Technica or for information about the complete current line of products please go to www.elementtechnica.com

- At element we are currently working on addressing the size/weight issure of 3-D equipment and will soon have a smaller/ lighter version of the Quasar available and along side this there will be an ultra-light unit (shoe box sized) that will work with the SI-2K cameras and will be hand-holdable as well as Steadi-cam-able or mountable wherever you could mount a small motion picture camera.

- The availability of all of these will be announced through our website or through various press releases on the internet or through industry publications