

**Introduction to 3D Graphics Technology- Lesson Plan**

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## Project summary

- The module will observe and critique 3D imagery and the instruction will focus on an introduction to 3D technology using the NMCAC Gateway equipment. The course will introduce the student to historical 3D imagery and binocular vision to the current applications of digital 3D effects.
- In this lesson the learner will identify differences between Stereoscopic, binocular vision and parallax perceptions. The student will be able to describe 3D terms and concepts of how the brain uses parallax views to interpret dimensional space.
- In addition the student will observe anaglyphic images by using Internet resources. To conclude the student will evaluate current trends in 3D imagery.
- This module will be inserted into UNM Taos CT 213 Multimedia 2 class that will be offered in the fall 2012. The concepts and ideas have the flexibility to be applied to create imagery that will engage student learning by using the applications of Adobe Premiere Pro, Stereoscopic Player, and other non linear editing programs.

## Objectives:

- (1) Comprehend terminology and history of 3D imagery.
- (2) Research and review existing technology.
- (3) Critique existing 3D technology.
- (4) Evaluate the differential between 3D technologies.

## Materials:

1. 2- Mitsubishi DLP 3D Display, WD 65 inch plasma TV 1080.
2. Quadro Pro 4800 Graphic Card.
3. 3D Glasses
  - a. Passive
    - i. Anaglyph glasses
    - ii. Linear polarized glasses
    - iii. Circular polarized Real 3d
  - b. Active LCD Shutter
    - i. NVIDIA 3D Vision Video Player
4. Transmitter
5. View master Viewer/ Stereoscopic
6. 25 View Master reels.
7. 3d Stills
8. DVfab- 3d
9. Stereoscopic Player
  - a. For left eye & right eye,
10. Photoshop
  - a. Text to 3d effect for visual ques..
11. Panasonic HDC- SDT750
  - a. HD writer AE 2.6T (High Definition video Management/ Easy Editing Software)
    - i. 1080/ 60P
    - ii. AVCHD format
      1. HA 1920- 17 Mbps, HG 1920- 13 Mbps, HX 1920- 9 Mbps, HE 1920 6 Mbps
12. Sony HXR-NX3d1, compact camcorder.

13. Geo Force, 3d vision. GoPro CineForm Studio. View modes, parallax, cross, anaglyph, Dubois, mirror, wiggle, A/B.

## Lessons

### **History of 3D technology,**

- a) Intro –In 1830 Sir Charles Wheatstone successfully created stereo 3D viewing techniques, which vividly brought to life centuries of discourse on how we see the world. Euclid, Da Vinci and countless other mathematicians, artists and physicists had often speculated on the simple difference one would observe if viewing the world first through the left eye only and then through the right eye only in turn. (Bellamy 2010)  
[http://en.wikipedia.org/wiki/Charles\\_Wheatstone](http://en.wikipedia.org/wiki/Charles_Wheatstone)
- Edwin Herbert Hand- Edwin Herbert Land (May 7, 1909 – March 1, 1991) was an American scientist and inventor, best known as the co-founder of the Polaroid Corporation. Among other things, he invented inexpensive filters for polarizing light. (wiki 2012)
- b) Overview of 3-D TV technology. Common stereoscopic approaches involving several conventional cameras and computer graphics techniques to describe the recorded scene for later viewing. Stereoscopy is the most widely accepted technique for the capture and display of 3-D content. Stereoscopy is based primarily on human visual perception [6]. The images perceived by the two human eyes when looking at an object are slightly different. The two slightly different images received by the eyes play an important role in depth perception. This disparity in the horizontal positioning of objects between the two eyes causes the brain to merge the two images to create the perception of a single 3-D view [2]. In 3-D TV, it is possible to create the same perception by using technology that exploits this basic human physiology. A typical stereoscopic approach involves two cameras (referred to as a stereo camera) to capture scenery from viewpoints corresponding to the human eye positions [2]. The display system presents the viewer with two sets of slightly different images, one for each eye. The disparity information contained in the dissimilar images creates the "sensation of depth and presence" for the viewer [3]. Such systems typically require viewers to wear special glasses to ensure that each eye only sees the one corresponding view it is supposed to perceive. One common deficiency is that most stereoscopic systems create mismatches between different 3-D cues in human perception. This creates discomfort for the viewer often in the form of eye fatigue. This is common if the stereoscopic video has alignment problems [9]. On the other hand there are active holographic techniques. Unlike stereoscopy, holography is based primarily on the principle of duplicating the physical light distribution in the viewing space. The quality of the 3-D image is dependent on the success in duplicating the physical properties of the original light [6]. If the duplication is perfect, the viewer will see exactly the same 3-D environment as the original 3-D scene [9]. Holography is a true 3-D imaging technique. However, there are many physical restrictions associated with holography which prevent such perfect duplication. Recent advances in CCD and CMOS imaging technologies are promising and the quality of displays has been improving [6]. (Sharif, Sharif & Munir 2010)
- c) Stereoscopy (also called stereoscopies or 3D imaging) is a technique for creating or enhancing the illusion of depth in an image by means of stereopsis for binocular vision. The word stereoscopy derives from the Greek "στερεός" (stereos), "firm, solid" [2] + "σκοπέω" (skopeō), "to look", "to see". [3]

Most stereoscopic methods present two offset images separately to the left and right eye of the viewer. These two-dimensional images are then combined in the brain to give the perception of 3D depth. This technique is to distinguish from 3D displays that displaying an image in three full dimensions which gives the observer the possibility to increase information about the 3-dimensional objects being displayed by head and eyes movements. (wiki 2012)

### **Who, What, When, How, 3d works**

- i) <http://entertainment.howstuffworks.com/digital-3D1.htm> How things work, How is digital 3D different from old 3D. movies
- ii) Watch and critique- Trailers
- iii) Powerful depth cue is stereopsis. Stereopsis is the ability of our brain to take two input images from different perspectives and gain an understanding of how far away two different objects are in relationship to each other. The key point to understand is that since our eyes are spaced apart on our heads, each eye can view a slightly different perspective of the world in front of us. **Look at an object nearby and close one eye, then switch eyes back and forth several times.** Then try this same exercise on an object that is far away. You notice that the object that that is nearby jumps from side to side in your field of view a lot more drastically than the object far away. If the close object is in the same general direction as the far away object, the close object switches sides of the far away object. This is the basis of how stereopsis works. Your brain takes the relative horizontal distance between objects in your field of view and compares them to gain an understanding of where those objects are in relationship to each other in terms of depth. It is theorized that pigeons bob their head in order to gain depth perception (since their eyes are on opposite sides of their head and they can't see depth otherwise). If you look through only one eye, you lose your stereopsis depth cue. However if you bob your head from side to side with that eye still closed, you can get a sense of depth again. This separation between eyes that provides different perspectives is the key to stereopsis. (After Effects 2012)

### **Short history**

- i) 3d- <http://youtu.be/DhE-JS-bVbM> 0- 56 seconds.
- ii) Stereoscopy- Stereoscopy is a digital technique for allowing our brain to see stereopsis by tricking it. This technique is done is by presenting each eye with a different image. The left eye is presented a view of a scene from some virtual or real camera that shows the left perspective. Similarly, the right eye is presented with an image of the right perspective. In this way, each eye is presented with a different image independently and our brain puts them together, and we perceive depth. When viewing a stereoscopic 3D scene on a monitor, the elements in the scene have a tendency to pop out or sink into the screen. Stereopsis is telling us that the object is closer or farther away from us than how far away the monitor actually is. (After Effects 2012)
- iii) Anaglyph imagery, - Many different devices and systems exist for delivering stereopsis to our brains. But in general the principle behind all of them is the same; get one eye to see one view, and the other to see a different perspective of the same scene. Anaglyph glasses are the oldest method, and by far the cheapest. Different colored lenses color

filter each eye's view differently. Red-blue glasses filter out blue on the left eye and red on the right eye. On the display side, the left image is colored red, and the right is colored blue. Then the images are overlapped. Each eye sees only the associated image. Because of the inherent color distortion, it is difficult to see all the colors accurately using anaglyph. (After Effects 2012)

(1) Write a red *R* and a blue *B* on white paper with crayons. Now look at these letters through a red filter—a material that passes red light only. You do *not* see the *R*! Why not?

- ii) Active shutter glasses work by blocking one eye at a time at a high rate (usually 60fps) and switching the left and right images every frame while synchronized with the monitor. Some TVs use no glasses at all, such as those from Alioscopy. Alioscopy uses lenticular technology, in which the lens on the monitor itself actually refracts the lights in different directions so that each eye gets a different perspective simply by being in a different location in relationship to the TV. (After Effects 2012)

(1) GeForce 3d vision glasses

- ii) Polarized- glasses work on a simple principle. Two images are displayed on a screen, one image emits horizontally polarized light only, and one emits vertically polarized light only. The glasses have polarized lens such that each only lets through light polarized in one direction. Right and left, circularized, can move your head, unlike linear polarization. (After Effects 2012)

(1) Close left and right eye with polarization-

(a) <http://youtu.be/PDzkRmOmwfA> - linear or circular 8minutes.

**Activity- Learn terminology of the technology, Glossary - Goto WebCT assessment.**

- a) Human 3D perception- Our ability to combine the two images our brain receives from our eyes, to perceive
- b) Anaglyph-3D -This method produces two slightly offset images tinted in either red or cyan. The red-cyan glasses then filter the light appropriately and the brain merges the two different images to produce a 3-D effect.
- c) Polarized 3D- This method involves even and odd pixel lines in the display containing information for the left and the right eye, respectively, so that each individual eye only sees the image intended for it. The front of the display has polarizing filters that correspond with accordingly polarized glasses worn by the viewer. The two eyes of the viewer receive different images creating the "depth impression" [3]. This is the main method that will be used by 3-D TV.
- d) Active Shutter 3-D. This method involves alternating frames containing the respective images for the left and right eye in a time sequenced manner. The viewer's glasses open and close the shutters to ensure each eye sees the correct image. This technique requires shutter-equipped eyeglasses that are "synchronized with alternating image frames" [3].
- e) Auto-stereoscopy- The necessity to wear glasses has been seen as a major obstacle to widespread acceptance of 3-D TV systems. The advent of auto-stereoscopic displays has

eliminated the need for glasses. The most common auto-stereoscopic displays use a plastic lenticular sheet composed of many tiny lenses placed in front of an LCD screen. These lenses redirect the light coming from each pixel in such a way that each eye perceives a different view. A typical auto-stereoscopic display could produce up to 16 different views of a scene compared to a conventional TV, which produces only one [3]. At present this display technology is primarily available for professional markets. It is expected that it will be made available for home use in the near future.

Other non-stereoscopic 3-D TV display techniques include holographic and volumetric displays. In holographic 3-D displays the image is formed using wave-front reconstruction [6]. This includes both real and virtual images. At present, there are experimental and limited-capability holographic display devices available [9]. A successful, large scale, fully interactive holographic 3-D display requires many parallel technological developments before it can be realized. Volumetric displays form the 3-D image using projection within a volume of space without using light interference [6]. Currently these displays tend to have limited resolution. (Sharif, Sharif & Munir 2010)

- f) Monoscopic depth cues- rely on some sort of previous knowledge of the viewed object.
- g) Texture gradient- If a texture has a repetitive pattern, it will appear to get smaller as it recedes towards the horizon.
- h) Occlusion- If the building hides half the man, it means that the building is in front of him. Therefore, you're looking at a giant or a scale model.
- i) Atmosphere blur- Particles suspended in the air blur and desaturate the image of distant objects.
- j) Cast shadows and specular highlights- The shadows cast by this light source are depth cues for recessed surfaces.
- k) Previous knowledge of shapes- We have a memory of the shape of every object we've already encountered.
- l) Position relative to Horizon- Where our line of sight hits the ground, defines one end of our visual range, the horizon is the other end.
- m) Definition of Parallax- is the relative position of an object's image in a set of pictures.
- n) Parallax induced by POV movement- Every time you move your head, you're generating motion parallax and your brain makes sure it gathers information.
- o) monoscopic depth cues include- Parallax induced by subject motion, Parallax induced by point-of-view motion, Objects apparent and relative speed
- p) Stereoscopic depth cues- using our two eyes as two points of view, and we make comparisons
- q) Horizontal Parallax- When you are looking at a stereoscopic picture, your brain extracts and computes the size of the disparities to assess the distance of the objects.
- r) Occlusion revelations- Occlusion occurs when objects overlap each other

- s) Binocular vision consists of combining the images of our two eyes- Some species use it only to widen their visual field, Some species use it to generate depth perception, in a process called stereopsis, Stereopsis is only one of the many ways we reconstruct 3D, Stereoscopic imaging simulates 3D by combining a pair of 2D images, Achieving this is called fusing the images
- t) Stereopsis- Our ability to combine the two images our brain receives from our eyes, to perceive depth
- u) Stereoscopic vision- Stereoscopic vision describes the use of two points of view with overlapping visual fields to perceive 3D volumes. It needs coordinated use of both eyes and is hardwired in our brain. Stereoscopic cinema simulates it by showing two flat images, one per eye. Stereoscopy is only one of the many ways we can see 3D objects in depth. 2D still pictures can represent a 3D world using monoscopic depth cues. Animated 2D images, like movies, extend this representation using motion-based depth cues. Despite the film medium being 2D, classic movies are not experienced as a "flat medium." Depth perception is a feeling extracted from flat stimuli. Color and basic shape information are actual perceptions occurring in our eyeballs' retina. Movement and depth cues are generated in the brain visual cortex.
- v) Interocular distance- The distance between the cameras is the single most important parameter in stereoscopy. It will regulate the strength of the 3D effect. Pull the cameras apart and your subject will grow. Push the cameras together and it will shrink.
- w) Convergence- The second most important parameter in 3D photography is the convergence point, and sometimes its very absence. If your two camera axes are parallel, your 3D picture will be 100 percent in front of the screen. The only perfectly overlapping objects will be the ones at an infinite distance to the cameras. They will show no 3D disparity at all, for the interocular distance has no effect on their images.
- x) Orthostereoscopy- A 3D image is orthostereoscopic when it perfectly replicates human vision. 2.5-inch rule is meaningful in a specific sort of stereography, called orthostereoscopy.
- y) depth effect is a function of- 1. the relative position of the two cameras & 2. The projection screen size and the viewer's relative position to the screen
- z) Side by side- Images are squeezed in the left and right halves of the screen
- aa) Over/under- Images are squeezed in the top and bottom halves of the screen
- bb) Row interleaved- Every other row of each eye is selected to compose the image
- cc) Raw checkerboard- Every other pixel is selected
- dd) Anaglyph- left and right are encoded in color spaces (Mendiburu 2004)
- ee) Depth of Field- depth of field (DOF) is the distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image.
- ff) Codec- is a device or computer program capable of encoding or decoding a digital data stream or signal. The word codec is "coder-decoder" or, less commonly, "compressor-decompressor".

- gg) AVCHD- Advanced Video Coding High Definition)[1] is a file-based format for the digital recording and playback of high-definition video
- hh) MTS files- MPEG transport stream (MPEG-TS, MTS or TS) is a standard format for transmission and storage of audio, video, and Program and System Information Protocol (PSIP) data.[7] It is used in broadcast systems such as DVB, ATSC and IPTV. Transport Stream is specified in MPEG-2 Part 1, Systems (formally known as ISO/IEC standard 13818-1 or ITU-T Rec. H.222.0).
- ii) MVC- Multi-view Video Coding (MVC) is an amendment to H.264/MPEG-4 AVC video compression standard developed with joint efforts by MPEG/VCEG that enables efficient encoding of sequences captured simultaneously from multiple cameras using a single video stream.
- jj) AVI- Audio Video Interleaved (also Audio Video Interleave), known by its initials AVI, is a multimedia container format introduced by Microsoft in November 1992 as part of its Video for Windows technology.
- kk) MOV- QuickTime File Format (QTFF/ Mov) is a computer file format used natively by the QuickTime framework
- ll) BD- is an optical disc storage medium designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs. Conventional (pre-BD-XL) Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the industry standard for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for BD-XL re-writer drives.
- mm) MPEG-2- is a standard for "the generic coding of moving pictures and associated audio information".[1] It describes a combination of lossy video compression and lossy audio data compression methods which permit storage and transmission of movies using currently available storage media and transmission bandwidth.
- nn) SDHC card- Secure Digital or (SD) is a non-volatile memory card format for use in portable devices. The Secure Digital standard is maintained by the SD Card Association (SDA). SD technologies have been implemented in more than 400 brands across dozens of product categories and more than 8,000 models. High-Capacity (SDHC).
- oo) Binocular vision is vision in which both eyes are used together. The word binocular comes from two Latin roots, bini for double, and oculus for eye.

### ***Observe and critique the technology***

#### **a) Examples- Web links**

##### **i) Good and bad-**

- (1) Ted Talks: Brave Neuro World – 2011 – Ep. 5 S1:E5 “Al Seckel says our Brains are Mis-wired” a neuroscientist explores perceptual illusions. Not only are we easily fooled, we kind of like it. Netflix

<http://movies.netflix.com/WiPlayer?movieid=70232771&trkid=3326878>

(a) What is wrong with this picture? Illusions and perceptions.



- (i) Crazy Nuts by Jerry Andrus. 1:31- 2:44 – minutes or Youtube.  
[http://youtu.be/fox9uP\\_9TTg](http://youtu.be/fox9uP_9TTg)
    - (ii) The infinite staircase-
  - b) The student will know where to obtain further resources on the World Wide Web
    - i) See **Web links**
- 2) Demonstrate knowledge of the hardware and software of multimedia;
  - a) **Activity** – create anaglyphic images motion picture
    - (1) Create/Set up sequence> DV playback> AVCHD> 1080 p 30 or 60 fps>>
    - (2) Import clip>> left eye & right eye- make a sub clip if only using one image.
    - (3) Right eye>> channel 1>>
    - (4) Left eye >> channel 2>>
      - (a) Goto RGB color balance control>>
        - (i) channel 1>> red off + green & blue 100%
        - (ii) channel 2>> red 100% on + green & blue off
      - (b) Goto>> Effect control >> change opacity>> on Left eye video >>linear dodge add
      - (c) Change convergence>> by changing the position of the top video>> move to the negative.
  - b) Create side by side motion pictures in Premiere
    - (1) Create a new sequence
    - (2) Adjust scaling>> not uniformly
      - (a) Scale>> left eye 50% width
      - (b) YouTube standards>>
        - (i) Right eye goes on the left side and
        - (ii) Left eye goes on the right side. <http://youtu.be/KbFhduJobss>
- 3) Activity Photoshop
  - a) Edit AVCHD in PS and open in Stereoscopic player. -
  - b) Anaglyphic images <http://stereo.gsfc.nasa.gov/classroom/3d.shtml>
  - c) Visual cues with 3d Photoshop action demo. <http://youtu.be/C-tC5wG7ueY>
    - i) Start film>1080/29.97

- ii) Load action,
  - iii) open glow.png
- 4) Activity- Stereoscopic Player,
- a) Left eye & Right eye stills
    - i) View Master for face to face
    - ii) Download
      - (1) web links <http://www.stereomaker.net/sample/stph02.htm>,
  - b) Reef 3 minutes- 2:22
  - c) Space station- 18:27-30:00
  - d) Puss & Boots- 11:45- 15:04
  - e) Panasonic
    - i) Sunset time lapse
    - ii) Time lapse mountain
    - iii) Hummingbirds 7/12/12 11252- 11201
  - f) Sony Images- Left & right eyes in Stereoscopic player
    - i) Humming birds.
    - ii) Sunrise & sunset
  - g) GoPro Cineform Studio- left and right eye John Dunn Bridge.

### **References**

- 3D Puss in Boots (2011) DreamWorks Home entertainment
- After Effects Help (n.d) Understanding Stereoscopic 3D in After Effects, Retrieved 4/12/12 from <http://helpx.adobe.com/after-effects/kb/stereoscopic-3d-effects.html>
- Bellamy, Andy (2010) Pro 3DStereoscopic 3D Workflows for Apple-centric Post Production. Retrieved May 2012 [http://cineform.com/pdfs/Pro3D\\_whitepaper\\_101109.pdf](http://cineform.com/pdfs/Pro3D_whitepaper_101109.pdf)
- Enhanced Dimensions (2011) 3D Tutorial - Create Stereoscopic 3D Videos for YouTube using Adobe Premier. Retrieved from <http://youtu.be/KbFhduJobss>
- IMAX Under the Sea 3D (2009) IMAX corporation, Toronto Canada, Warner Bros. Entertainment. <http://imax.com>
- IMAX Space Station 3D (2010) IMAX corporation, Toronto Canada, Warner Bros. Entertainment Lockheed Martin in cooperation with NASA <http://imax.com>
- Mendiburu, Bernard (2004) 3D Movie Making: Stereoscopic Digital Cinema from Script to Screen. Publisher Elsevier, Inc. Retrieved 6/26/12 from UNM Taos online database, <http://taos.unm.edu/library/databases.html>
- Sharif, Lukman, Sharif Nauman and Ahmed Munir (2010) 3-D Television. International Journal of Research and Reviews in Information Sciences Vol. 1 No. 1 Retrieved 6/26/12 from UNM Taos online database, <http://taos.unm.edu/library/databases.html>
- [3] Estall, L. (2008). The future of TV: Illusions of reality in 3D. Eye on Technology, 2007, Issue 7. Communications Research Centre Canada
- [6] Onural, L., Sikora, T., Ostem1ann, J., Smolic, A., Civanlar, M.R., & Watson, J. (2006). An assessment of 3DTV technologies. NAB BEC Proceedings
- (9) Onural, L. (2009). Research Trends in Holographic 3DTV Displays. Proceedings of the IEEE, LEOS Annual Meeting Conference Proceedings, 2009. p6-7
- Ted Talks (2004) Ted Talks Brave Neuro World Season 1: Ep. 5 Al Seckel Says our brains are Mis-wired <http://movies.netflix.com/WiPlayer?movieid=70232771&trkid=3326878>

## Web links

3d anywhere anytime. - Color code 3d [http://www.colorcode3d.com/ColorCode\\_3-D.html](http://www.colorcode3d.com/ColorCode_3-D.html)

3D Glasses - Polarizing - 3D based on polarizing lenses is today's topic. In this video I do visual demonstrations of linear and circular (As in RealD 3D system) polarizing glasses.  
<http://youtu.be/PDzkRmOmwfA>

3D Lessons Deliver Higher Levels Of Understanding And Increased Focus To Students Across Europe - Contact: Henrietta Mackenzie hmackenzie@waggeneredstrom.com LONDON – September 29, 2011, 12:00 p.m. GMT: Texas Instruments (TI) (NYSE:TXN) DLP® Products presents data that shows 3D, when used as a teaching tool in classrooms, has a widespread positive impact on how students learn. The independent study is announced today at the UK launch event in Claridges, London and hosted in collaboration with The Company of Educators. Conducted in classrooms across seven European countries, the research compares the difference in comprehension, information retention and overall behavior between students learning via traditional 2D methods versus learning via 3D projection.  
<http://www.dlp.com/uk/technology/dlp-press-releases/press-release.aspx?id=1508>

3dtv.at Products - 3dtv.at Products downloads [http://3dtv.at/Downloads/Index\\_en.aspx](http://3dtv.at/Downloads/Index_en.aspx)

3D Tutorial - Create Stereoscopic 3D Videos for YouTube using - Stereo 3D Tutorial - Learn the basics of creating Stereoscopic 3D videos from a left and right video sequence using Adobe Premiere. Output as red cyan anaglyph for old school 3D glasses, or side by side for 3D YouTube yt3d or 3D TV viewing! Use two cameras or a stereo video camcorder to record left and right videos. <http://youtu.be/KbFhduJobss>

3-D Zone - Ray Zone is one of the leading champions of 3-D in the world. He has been called the King of 3-D Comics. Before you scroll down to Ray's 3-D Libraries below, you can first read about his work on the Tom Jane 3D feature film The Dark Country or Brijes 3D, the animated 3-D feature film that Ray produced in Mexico. Click on Talkin' About 3-D Comics to see an anaglyph 3D movie of Tom Jane interviewing Ray about making 3-D comics or read about the books Ray Zone has written about 3-D Movies. And, finally, you can check out Whatever Happened to Ro-Man? This is Ray's revealing new 3D film, an interview with Ro-Man, the famous 3-D movie star of the 1953 "Golden Turkey" Robot Monster  
<http://www.ray3dzone.com/>

Anachrome- Allan Silliphant, your host, I am an inventor, and a 3D film maker with 40 years experience. <http://www.anachrome.com/>

A Short History Of 3D Part 2 (2006) I look at how 3D films work, the era of classic dimensional movies from the 50s and the resurgence of new 3D films <http://youtu.be/BG9RcWBtAkk>

A Universe of Questions - This video explores how astronomers are utilizing the TeraGrid as a distributed computing environment to compute massive simulations that visualize simulations of galactic formation and evolution in order to further understand the cosmos.  
<http://3d.iu.edu/astronomy>

Binocular cues - Binocular cues provide depth information when viewing a scene with both eyes. Stereopsis or retinal (binocular) disparity - Animals that have their eyes placed frontally can also use information derived from the different projection of objects onto each retina to

judge depth. By using two images of the same scene obtained from slightly different angles, it is possible to triangulate the distance to an object with a high degree of accuracy. If an object is far away, the disparity of that image falling on both retinas will be small. If the object is close or near, the disparity will be large. It is stereopsis that tricks people into thinking they perceive depth when viewing Magic Eyes, Autostereograms, 3-D movies and stereoscopic photos. Convergence - This is a binocular oculomotor cue for distance/depth perception. By virtue of stereopsis the two eye balls focus on the same object. In doing so they converge. The convergence will stretch the extraocular muscles. As happens with the monocular accommodation cue, kinesthetic sensations from these extraocular muscles also help in depth/distance perception. The angle of convergence is smaller when the eye is fixating on far away objects. Convergence is effective for distances less than 10 meters.[citation needed] Shadow Stereopsis - Medina demonstrated that retinal images with no parallax disparity but with different shadows are fused stereoscopically, imparting depth perception to the imaged scene. He named the phenomenon "shadow stereopsis." Shadows are therefore an important, stereoscopic cue for depth perception.

[http://wkp.maluke.com/en/Depth\\_perception#Binocular\\_cues](http://wkp.maluke.com/en/Depth_perception#Binocular_cues)

Depth perception - Depth perception is the visual ability to perceive the world in three dimensions (3D) and the distance of an object. Depth sensation is the ability to move accurately, or to respond consistently, based on the distances of objects in an environment.[citation needed] Depth perception arises from a variety of depth cues. These are typically classified into binocular cues that require input from both eyes and monocular cues that require the input from just one eye.[1] Binocular cues include stereopsis, yielding depth from binocular vision through exploitation of parallax. Monocular cues include size: distant objects subtend smaller visual angles than near objects. [http://wkp.maluke.com/en/Depth\\_perception](http://wkp.maluke.com/en/Depth_perception)

DLP® 3-D HDTV Technology - Technology for the first DLP® 3-D television was introduced to Display ODMs in 2007. Utilizing the inherent speed advantages of the Digital Micro mirror Device (DMD), this technology displays the left and right views required for stereoscopic, or 3-D imaging. When combined with shutter glasses, users will experience high quality, high definition 3-D viewing with DLP® HDTVs. <http://dlp.com/downloads/DLP%203D%20HDTV%20Technology.pdf>

Edwin H. Land- Edwin Herbert Land (May 7, 1909 – March 1, 1991) was an American scientist and inventor, best known as the co-founder of the Polaroid Corporation. Among other things, he invented inexpensive filters for polarizing light, a practical system of in-camera instant photography, and his retinex theory of color vision. His Polaroid instant camera, which went on sale in late 1948, made it possible for a picture to be taken and developed in 60 seconds or less. [http://en.wikipedia.org/wiki/Edwin\\_H.\\_Land](http://en.wikipedia.org/wiki/Edwin_H._Land)

GoPro Tutorial - A tutorial on the basic functions for shooting video, timelapse stills and overall settings of the GoPro Hero HD Camera. <http://youtu.be/xOXvthSDXvY>

How do 3D glasses work - Professor Phil Moriarty's explanation of 3D glasses. How do 3D films give us that three dimensional effect? <http://youtu.be/quoySiCVffw>

Illustrated 3D Movie List - High-quality 3D movies can now be seen in thousands of new generation 3D theaters all around the world - including IMAX 3D (digital and 70mm film), REAL D 3D, Dolby 3D, XpanD 3D cinemas and more (see FAQ). The 1950's and the 1980's were also very big years for 3D movie production <http://www.3dmovielist.com/>

Imax - The large-format inventor IMAX 3D <http://www.imax.com/>

Inition - Headquartered in Shoreditch, east London, we are a pioneering creative 3D technology company. Underpinned by 10 years of experience, we are a flexible and dynamic team, pushing boundaries <http://www.inition.co.uk/>

Leading the way into the Future - This video explores how weather researchers are using the TeraGrid as a distributed computing environment to process huge amounts of data to maximize placement of resources to harvest wind energy, help farmers with long term weather models, and forecast severe weather in real time. Fun Facts: The computer-generated tornado scene simulates an F2 tornado. All of the farm scenes were shot just outside of Indianapolis, Indiana. If you look closely at the pond in the wind turbine scene, you may see a fish jump. This video took a team of professional staff and students more than 500 hours to produce. All of the live-action stereo video was filmed using high-definition stereoscopic camera rigs designed and built by staff from the Indiana University Advanced Visualization Lab <http://3d.iu.edu/weather>

LOREO- Loreo designs innovative 3D cameras, 3D lenses and optical systems for consumers and professionals. Our products are designed to be practical and reliable, and are perfected through exhaustive testing. <http://www.loreo.com/>

Louis Marcoux blog - 3D Roadie <http://area.autodesk.com/blogs/shawn>

Louis Marcoux tutorials - In this section, you will find small video clips that cover various tips and tricks in 3ds max. All clips are shorter than 10 minutes and if a subject needs more than 10 minutes, it will always be broken in smaller parts. You will find all levels of tips here and this is on purpose. From beginner to advance, the clips are all based on common questions asked after public demonstration, at pods on the show floor of various conventions or simply during personal discussions. I have tried to make these videos useful for everybody. <http://louismarcoux.com/MaxTips.htm>

Luma Chroma for windows - This page demonstrates LumaChroma, my work-in-progress Premiere/After Effects video processing plugin <http://gl.tter.org/LumaChroma3D/>

Magic 3D Photoshop Action - a free Photoshop Action for easily creating 3D effects. <http://vandelaydesign.com/blog/tools/magic-3d-photoshop-action/>

Make a 3D Movie : 4-Minute Film School- Sick of making BORING two dimensional movies? Watch this episode to learn how to shoot and edit 3D video and even build a rig just for 3D movie making. <http://youtu.be/V6Nuaf08wTs>

Panasonic Partners with Bexel on Gear for 3D Broadcast - By Bryant Frazer / Sep 1, 2010 At the U.S. Open Tennis Championships that kicked off this week in New York City, Panasonic sought to present itself as a purveyor of all things 3D, noting that stereo 3D broadcasts of matches this weekend and next on DirecTV's n3D channel were leaning heavily on Panasonic technology. At a press event on Wednesday morning, Panasonic North America CTO Eisuke Tsuyuzaki announced a new partnership between Panasonic and Bexel, and the companies unveiled a 3ality-branded 3D rig using two Panasonic AK-HC1500 1080i/720p cameras in a beamsplitter configuration. <http://www.studiodaily.com/2010/09/panasonic-partners-with-bexel-on-gear-for-3d-broadcast/>

- Polarized 3D system - A Polarized 3D system uses polarization glasses to create the illusion of three-dimensional images by restricting the light that reaches each eye, an example of stereoscopy. [http://en.wikipedia.org/wiki/Polarized\\_3D\\_glasses](http://en.wikipedia.org/wiki/Polarized_3D_glasses)
- SENSIO - SENSIO has developed a proprietary optimization of the checkerboard subsampling. They also acquired some IP in real-time conversion from JVC and repackaged it with their 3D format and other 3D formats conversion into a single chip to be integrated in 3DTV sets. <http://www.sensio.tv/>
- Stereo 3d - stereo 3d board <http://www.stereo3d.com/cgi-bin/discus/discus.cgi>
- Stereo Movie Sample - Stereo Movie Samples <http://www.stereomaker.net/sample/index.html>
- Stereo Photo Samples 2 - Stereo Photo Samples 2  
<http://www.stereomaker.net/sample/stph02.htm>
- Stereo Movie Sample a - Stereo Movie Sample <http://www.stereomaker.net/sample/index.html>
- Stereoscopic (3D) Imaging by Andrew Woods - This site contains a range of information about stereoscopic (3D) imaging, stereoscopic video, and other 3D technologies  
<http://www.andrewwoods3d.com/>
- Stereoscopic 3D Workflows with Adobe CS5.5 Production Premium - About This Episode Join Adobe evangelist Jason Levine to learn how Adobe Premiere Pro CS5.5 powers efficient, convenient and flexible editing and post-production workflows when working with stereoscopic content. <http://tv.adobe.com/watch/adobe-at-nab-2011/stereoscopic-3d-workflows-with-adobe-cs55-production-premium/>
- Stereoscopic 3D Workflows for Apple-centric Post Production - White paper By Andy Bellamy - Creative Director Pro3D [http://www.cineform.com/pdfs/Pro3D\\_whitepaper\\_101109.pdf](http://www.cineform.com/pdfs/Pro3D_whitepaper_101109.pdf)
- Stereoscopic 3D - Explaining the 3D movie experience - At Bug we have the experience, the know how and the creative talent to produce stereoscopic 3D content. Contact us for more information on how we can produce stereoscopic 3D animations and films for your company. <http://youtu.be/qIKzPgo2rNw>
- Stereoscopic Virtual Library - Welcome to the Stereoscopic Displays and Applications Virtual Library <http://www.stereoscopic.org/library/>
- Stereoscopy in 3ds Max with StereoCam Modifier - The blog post covers a wide range of knowledge on making stereoscopic CG with 3ds Max. And, most of all, you will learn the basics of making comfortable CG Stereoscopic images by taking the projection setup into consideration.  
[http://area.autodesk.com/blogs/louis/stereoscopy\\_in\\_3ds\\_max\\_with\\_stereocam\\_modifier](http://area.autodesk.com/blogs/louis/stereoscopy_in_3ds_max_with_stereocam_modifier)
- Stereoscopy - Stereoscopy (also called stereoscopics or 3D imaging) refers to a technique for creating or enhancing the illusion of depth in an image by means of stereopsis for binocular vision. Most stereoscopic methods present two offset images separately to the left and right eye of the viewer. These two-dimensional images are then combined in the brain to give the perception of 3D depth. This technique is to distinguish from 3D displays that displaying an image in three full dimensions. The most notable difference to stereoscopic displays with



two images is that the observer's head and eyes movement will increase information about the 3-dimensional objects being displayed. <http://wkp.maluke.com/en/Stereoscopy>

**Stereopsis** - Stereopsis (from stereo- meaning "solid" or "three-dimensional", and oipsis meaning appearance or sight) is the impression of depth that is perceived when a scene is viewed with both eyes by someone with normal binocular vision. Binocular viewing of a scene creates two slightly different images of the scene in the two eyes due to the eyes' different positions on the head. These differences, referred to as binocular disparity, provide information that the brain can use to calculate depth in the visual scene, providing a major means of depth perception. The term stereopsis is often used as short hand for 'binocular vision', 'binocular depth perception' or 'stereoscopic depth perception', though strictly speaking, the impression of depth associated with stereopsis can also be obtained under other conditions, such as when an observer views a scene with only one eye while moving.[1] Observer motion creates differences in the single retinal image over time similar to binocular disparity; this is referred to as motion parallax. Importantly, stereopsis is not usually present when viewing a scene with one eye, when viewing a picture of a scene with both eyes, or when someone with abnormal binocular vision (strabismus) views a scene with both eyes. This is despite the fact that in all these three cases humans can still perceive depth relations. <http://wkp.maluke.com/en/Stereopsis>

**Trioviz** - This is INFICOLOR™ 3D ! Enjoy and share a full 3D experience on most HD 2D TV sets. You don't need a 3D TV to enjoy these games in full 3D. Our technology combines with INFICOLOR™ 3D glasses to give you a light-weight, high-quality experience <http://us.trioviz.com/en>

**TRU3D Stereoscopic 3D TV by tru3D01** <http://www.youtube.com/user/tru3D01>

**Understanding Stereoscopic 3D in After Effects** - Understanding stereopsis and stereoscopy To understand what stereoscopic 3D is, it's necessary to understand perceived depth. There are many cues that help us perceive depth. Objects in perspective, occlusion, and relative size are good indicators of depth. An object that is farther away is interpreted as such by our brains if it is much smaller than another object next to it. Our brain already knows how big those objects should be in relationship to one another. If two objects are roughly the same size in our field of view, and one is occluded by or is occluding another object, our brain infers that one of those objects is in front of the other. (Occlusion mean one object is laid on top of the other and obscures the other.) Paintings or games can appear 3D because they obey these rules. After Effects also obeys these rules when you create a 3D composition with a camera. <http://helpx.adobe.com/after-effects/kb/stereoscopic-3d-effects.html>

**Ways to Watch 3D - Types of 3D Formats** 3D is created by super-imposing two matching yet slightly offset 2D images on top of each other. This creates the illusion of 3D depth. Because of the distance between the human eyes, each eye processes the two images from a slightly different perspective and your brain then combines both images to form a single 3D image. The 3D HERO System captures 3D by filming two separate 2D videos from slightly different perspectives — similarly to how our two human eyes see the world from two slightly different perspectives. Then GoPro Cineform Studio software is used to combine and convert these two slightly offset videos into a single 3D video, just like our brains form a single “view” from our left and right eyes. Once this 3D video or photo file has been created, you can watch it on your computer, online, or on any 2D or 3D TV. <http://gopro.com/3d-ways-to-watch-3d/>



Welcome to STEREO TEC - You would like to start a project in 3D? STEREO TEC is a worldwide leading 3D equipment manufacturer and renowned service provider for high quality stereoscopic movie making <http://stereotec.com/>

Wikipedia: The free encyclopedia. (2012, August) – FL: Wikimedia Foundation, Inc. Retrieved

Summer 2012, [http://en.wikipedia.org/wiki/Charles\\_Wheatstone](http://en.wikipedia.org/wiki/Charles_Wheatstone)

<http://en.wikipedia.org/wiki/Stereoscopy>

[http://en.wikipedia.org/wiki/Polarized\\_3D\\_glasses](http://en.wikipedia.org/wiki/Polarized_3D_glasses)

[http://en.wikipedia.org/wiki/Edwin\\_H.\\_Land](http://en.wikipedia.org/wiki/Edwin_H._Land) <http://readtiger.com/wkp/en/Stereoscopy>

[http://readtiger.com/wkp/en/Depth\\_perception](http://readtiger.com/wkp/en/Depth_perception)

[http://readtiger.com/wkp/en/Depth\\_perception#Binocular\\_cues](http://readtiger.com/wkp/en/Depth_perception#Binocular_cues)

<http://readtiger.com/wkp/en/Stereopsis>

Whitehead (2012) YouTube Anaglyphic and side by side videos. <http://youtu.be/WwDb6Ezpx6Y>,

[http://youtu.be/uZ\\_n0LKtZww](http://youtu.be/uZ_n0LKtZww) <http://youtu.be/h2geC43ZFBE>