Suggestions for 3D display standardization

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outline

- What is the definition of 3D displays
- Difficulties of terminology for 3D displays
- Basic terminology of 3D displays
- Visual discomfort caused by 3D displays
- 3D visual comfort standardization
- Suggestion

What is the definition of 3D display

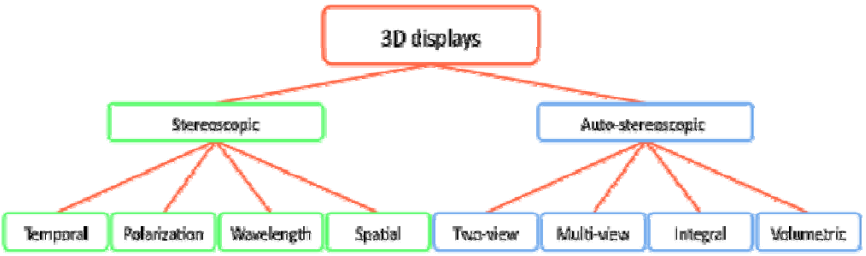
how to direct a different image to the left and right eyes

What is the definition of 3D display

3D display:

- Real 3D display displays an image in three full dimensions.
- The most notable difference to stereoscopic displays with only two 2D offset images is that the observer's head and eyes movement will increase information about the 3-dimensional objects being displayed.

Two broad categories for 3D display



the number of simultaneous views each display type has increases from left to right.

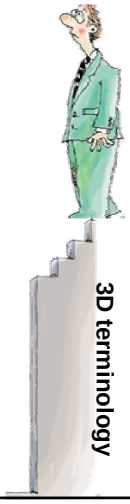
Difficulties of terminology for 3D displays

- Various technologies and methods
- Related to various technical fields
- Ambiguous/double meaning terms
- Historical transition of usage

Difficulties of terminology for 3D displays

some solutions:

- Clarifying scope of 3D display devices
- Correct and strict technical treatment
- Systematic description based on classified 3D display technologies



Basic terminology of 3D displays

Stereoscopic -Displays a 3D image through the use of glasses. Provides a different image to the viewer's left and right eyes, giving the viewer depth perception.

Auto-Stereoscopic-Displays a 3D image without the need for glasses.

Stereo pair -A pair of images that when viewed using a 3D display creates the illusion of depth. All stereoscopic 3D consists of a stereo pair in some form or another.

Crosstalk -See Ghosting.

Ghosting -Caused by signal leakage (crosstalk) between the two eyes when an image intended for the left eye appears partially in the right eye (or vice versa).

Parallax -This refers to the separation of the left and right images on the display screen. Positive Parallax puts objects behind the screen, Zero Parallax puts objects on the screen plane and Negative Parallax puts objects in front of the screen.

Basic terminology of 3D displays

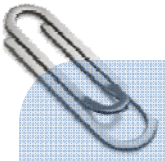
Depth Budget -The maximum positive and negative parallax to allow for comfortable 3D viewing, expressed as a percentage of screen width.

Holographic Displays -A holographic optical element (HOE) replace a more complex optical component.the result is usually an auto-stereoscopic display.

Two-view displays -These simply generate the individual left and right views and direct them to each of the viewer's two eyes. Typically the eyes must be in a sweet-spot to see the views although some designs can track the viewer's head movements so that the sweet-spot can be moved over a limited range to follow the eyes.

Multi-view displays -Multi-view displays extend the horizontal viewing freedom by simultaneously generating more than than two views. This results in a range of horizontal viewing positions at which the viewer can see a different but valid stereo pair. Additionally it allows a number of viewers to watch the same 3D display at the same time.

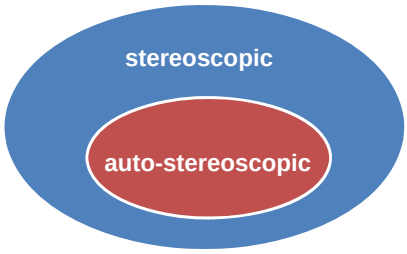
Some fundamental and important issues in 3D terminology

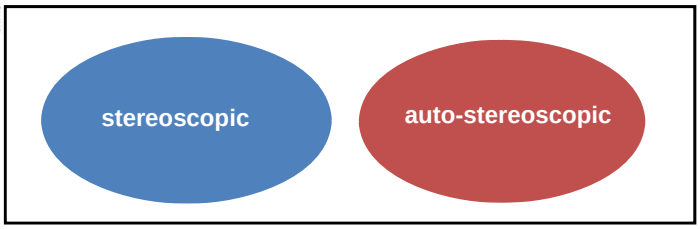


★Stereoscopic two-view (with glasses) or not?

★What is the relation between stereoscopic and auto-stereoscopic?

Which one is right?

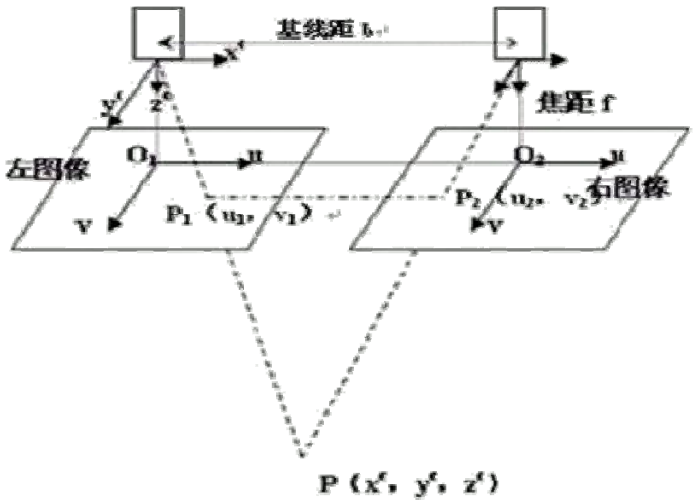




Visual discomfort caused by 3D displays

It is well known that some viewers experience visual discomfort when looking at 3D displays. Consequently, visual comfort certainly become one of the most critical topics. In view of this, we developed the health and safety test.

The study of health and safety test:

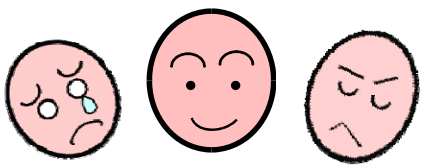


3D imaging principle diagram

The study of health and safety test:

3D imaging principle:

By interocular parallax, stereoscopic impression emerge in the other position different from the display surface on which interocular focus converges. If the difference between the focus and 3D imaging point is large, it will cause visual fatigue and discomfort. And then comfort parallax range is formed. Based on this principle, test activities are carried out.



The study of health and safety test

★Combined with the HVS characteristics ,we quantitatively research image comfort when we are watching 3D TV . By doing experiments, we can find the matching diagram of 3D image comfort (with a certain range of saturation) and then obtain the matching range of 3D image comfort.

★Defining some indicators that may lead to eye fatigue, nausea and other uncomfortable symptoms (such as image calibration, horizontal and vertical dislocation, chromaticity difference, brightness difference, the amount of parallax, fast scene switching ,2D/3D compatible switching, etc.)

★We define the safe range and related parameters so that the color mismatch and the image dislocation are maintained at an acceptable level

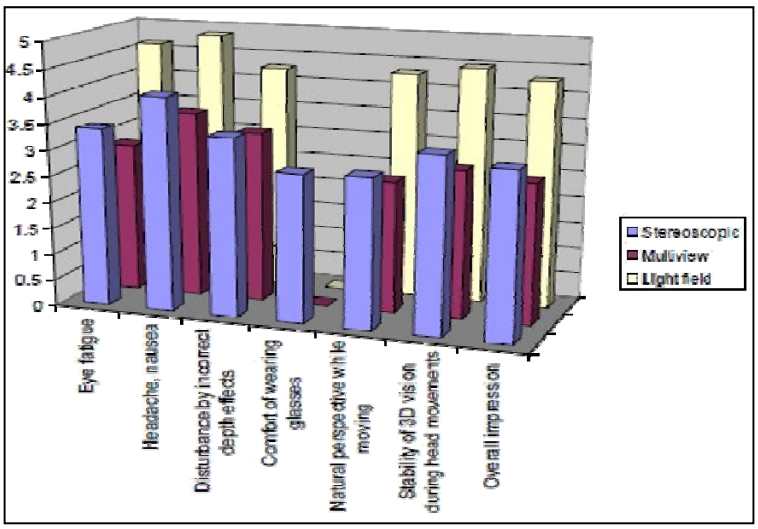
★Establishing guiding principles and best examples for 3D content creation and post-production, such as parallax depth and duration

Conclusions from user tests on the visual comfort of various 3D display technologies：

★Average viewers are less satisfied with the performance of the HD-panel based multiview auto-stereoscopic display than the glasses-based stereoscopic display, and even the advantage of being glasses-free cannot outweight this.

★The most important individual factors having serious impact on viewing comfort are eye fatigue and the necessity of wearing glasses.

★The light-field display outperformed the stereoscopic and mul-tiview display in all visual com-fort related factors.



Average scores for factors affecting visual comfort

the requirements to prevent visual fatigue and discomfort induced by viewing stereoscopic images were :

★The careful alignment in the right/left eye images is required for the stereoscopic vision without discomfort.

★The conflict between the demands for vergence eye movement and lens accommodation in the near response should be avoided, by using modest binocular disparity.

★The frequency of changes in binocular disparity should be restricted.

★The appropriate viewing distance is also recommended to avoid visual fatigue.

3D visual comfort standardization

★The horizontal and vertical parallax for 3D images and videos
★The luminance, contrast ratio, chromaticity, quality mismatch for 3D images and videos
★The horizontal and depth resolution for 3D images and videos
★The characteristics and format of flicker stimulation for 3D images and videos
★The compression and ambiguity (space frequency) for 3D images and videos
★The convergence of conversion relationship and viewing time fatigue by 3D images and videos
★The comfort test sequences and staff for 3D images and videos

Suggestion

★We should issue the policies to encourage, support and guide the construction of 3D content through C3D,and in particular promote the cooperation between manufacturing and content services. From the perspective of large-scale industry, we should actively promote the development of 3D industry, and have priority to supporting the construction of the industrial base and backbone enterprises of 3D development and production, and accelerate the construction of perfect 3D industry chain, and promote the rapid and healthy development of the 3D industry.

★We should promote the cooperation between 3D enterprises and scientific research institutes, and jointly study relevant 3D theory and technology (especially the naked eye 3D) , products and validation tests, standards and policies.

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