Chapter 17
3D Visual Experience

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Abstract. The large variety of different 3D displaying techniques available today can be confusing, especially since the term “3D” is highly overloaded. This chapter introduces 3D display technologies and proposes a categorization that can help to easily grasp the essence of specific 3D displays that one may face, regardless of the often confusing and ambiguous descriptions provided by manufacturers. Different methods for creating the illusion of spatial vision, along with the advantages and disadvantages will be analyzed. Specific examples of stereoscopic, autostereoscopic, volumetric and light-field displays emerging or already available in the market are referenced. Common uncompressed 3D image formats preferred by each display technology are also discussed.

1 Introduction

The chapter will go through the main technologies used for implementing 3D displays using the four top level categories of the “3D display family tree” created by the 3D@Home Consortium, Steering Team 4 [1]. It will take a different approach from that of the family tree detailing the main categories based on selected driving technologies that the authors think the most important. Other categorizations of 3D displays might exist, hopefully this one helps to understand the main trends and easily grasp the technology underlying different 3D displays.

The chapter strictly focuses on technologies that generate spatial vision, so it does not cover for example displays that project a floating 2D image using a fresnel lens, or displays that project 2D images on some surface(s).

2 Stereoscopic Displays

Stereoscopic displays [2,3] simulate 3D vision by showing different images to the eyes. The two images are either shown on a traditional 2D display, projected onto
a special surface, or projected separately to the eyes. Stereoscopic displays by definition all require some kind of eyewear to perceive 3D (otherwise they are called autostereoscopic, as seen later). Separation of the two images, corresponding to the left and right eye happens either time-sequentially, or by means of differentiating wavelength or polarization.

2.1 Time Sequential Separation

In the time sequential case, left and right images are displayed on LCD or PDP or projected one after the other, and then separated by shutter glasses that block incoming light to one eye at a time, alternating the blocked eye with the same frequency as the display changes the images. Such shutter glasses are usually implemented with LCDs, which become transparent and opaque synchronized with the display. Several companies provide shutter glasses based 3D solutions including LG [4], Panasonic [5], Toshiba [4], eDimensional [6] and NVIDIA[9], projectors with high refresh rate for stereoscopic operation [7,8], and NVIDIA also provides a stereo driver to use the glasses with PC games [9]. A stylish NVIDIA shutter glass can be seen in Fig. 1, with the IR sensor used for synchronization in the frame of the glasses.

Fig. 1 NVIDIA 3D Vision Glasses. Image courtesy of NVIDIA Corporation.

2.2 Wavelength Based Separation

Wavelength based separation is achieved by tinting the left and right images using different colours, overlaying the two and displaying the resulting 2D image. Separation is done by glasses with corresponding colour filters in front of the eyes, as done in the well known red-blue or red-green glasses. This method of creating