3D display technologies for integral imaging method

Shinichi Uehara
Corporate Research & Development Center, Toshiba Corporation,
1, Komukai Toshiba-cho, Saiwai-ku, Kawasaki 212-8582, Japan
Tel.: 81-44-549-2288, E-mail:sh.uehara@toshiba.co.jp

An integral imaging method is based on a novel photography method using a lens array for spatial image reproduction, which optically reproduces an object in space [1]. This method simulates light rays so that plural observers can see the surface of the displayed object. Recently, this method is extended to the light field rendering where the light rays in space are descbibed by their positions and directions. In both methods, the most popular structure is a combination of a fly-eye lens sheet and a high-resolution Flat-Panel Display. We have developed a one-dimensional (horizontal parallax only) integral imaging (1D-II) method, that adopts a lenticular sheet to provide only horizontal parallax [2]. We applied this 1D-II method to the glasses-free 3D TVs with 12, 20, and 55 inch diagonals [3].

For these glasses free 3D TVs, we have developed hardware and software technologies. Regarding the hardware aspect, we established uniform light ray technologies, such as moire-free pixel design [4], and viweing zone optimization method [5]. An LCD has pixel elements, such as TFT, pixel capaciter, signal lines, and black matrix pattern, and in order to reduce the moire, we have developled the pixel structure so that the sum of the shadowing highet should not be changed. Our viewing zome optimization method realizes to maximize the viewing zone. Regarding the software aspect, we have develoleped 2D/3D image conversion, 3D super-resolution, and face tracking technologies [6]. Our 2D/3D image conversion generates parallax images from one input 2D image using motion detection, scene classification, and face detection.

The integral imaging technologies are suitable for not only 3D TV, but also a medical display system. We also launched the medical 3D display imaging system in 2012 for presenting volume data of CT/MRI. The efficiency of surgical simulation is also improved [7], because the position of complex blood vessels can be verified easily. This system uses multi GPU volume rendering system in order to realize user interaction. We also applied the 1D-II to the flatbed-type 3D display systems [8], which is suitable for table-top applications. Recently, we have developed 32-inch 4K table top 3D display system.

For spreading 3D display applications, an LC gradient index lens (LC GRIN lens) is a good candidate for 2D/3D displays, because of simplestructure, high quality 2D/3D images, no luminance degradation, and LC manufacturing line applicable. In addition, the lens function can be easily changed by the lens electrode design and the applied voltages. For example, we have developed a portrait/landscape switchable 2D/3D display [9], a partially switchable 2D/3D display [10], a Fresnel LC GRIN lens with overdrive method [11], and an adapting 3D viewing angle display [12]. These LC GRIN lens technologies are for the lens optics, and therefore integral imaging rendering is also applied. In the future, more functions will be integrated into LC GRIN lens like ICs.

References

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