Guest Editorial
Three-Dimensional Displays and Visualization

THREE-DIMENSIONAL (3D) imaging and display is a natural concept for humans as it is a common vision attribute of our binocular vision, perception, and brain processing. However, until recently, our experiences have been mainly limited to the technologically inferior two-dimensional (2D) as evidenced from widespread use of 2D photography, cinema, and liquid crystal or LED-display for television, computer displays, etc.

There has been a tremendous effort in reaching 3D imaging systems for visualization and display, even if in the form of surrogates such as stereoscopy. Historically, from the conceptual point of view, one important step forward has been the invention of Holography by Dennis Gabor and the advent of the lasers (this year is the celebration for the 50th year invention of the laser). Nevertheless, holography also has deluded the high expectations for widespread 3D imaging and display due to the cumbersome problems connected with management of recording and high quality displays.

In the past decade, rapid development of digital technology for some key elements of 3D systems has renewed the hope for realizing the human pursuit for widespread and easy access to 3D imaging and display capability. These components include high-resolution pixelated detectors in all regions of electromagnetic spectrum, from UV to long IR; high power compact lasers, spatial light modulators, computation power of modern PCs, the vast data storage capability in combination with development of efficient algorithms, and new strategies in conceiving optical and optoelectronic setups.

This Special Issue on "Three-Dimensional (3D) Displays and Visualization" in the IEEE/OSA JOURNAL OF DISPLAY TECHNOLOGY offers the readers and the scientific community a special perspective with a collection of original and review research papers on the state-of-the-art in the field. 3D imaging and display have and will continue to have a very important role in our society with impacts from medicine to space or even deep see exploration as well as for entertainment, videogames, and cinema; or for training for pilots and surgeries.

The papers in this Special issue address key advances in selective topics of 3D Displays and Visualization. The readers will find a survey of recent developments in 3D imaging technologies (by Son *et al.*), where a depth analysis for multi-view imaging methods is performed. Also, some of the most recent innovations in 3D integral imaging are reported in this special issue. This is the case of the method reported by Navarro *et al.*, for remedying the image degradations due to the facet braiding effect. Bagheri *et al.* present a method to generate images with extended depth of field to support the realization of 3D imaging systems. In the paper presented by Arai *et al.*, integral imaging TV is implemented by using an ultra-high definition display panel. The paper by Large *et al.*, proposes to integrate the method of LED array and diffuse reflection for uniform illumination system with the aim of building flat-panel auto-stereoscopic displays. Another interesting research reported in this issue is the technique for the conversion from moving pictures into stereoscopic images (by Miura *et al.*).

An important part of this Special Issue is devoted to the application of digital holography to 3D imaging and display purposes. Yaras *et al.*, report a survey of the significant developments in electro-holographic displays in recent years. Gross *et al.* show that it is possible to reach the theoretical shot-noise limit in real time experiments by combination of off-axis geometry with phase-shifting recording conditions. Application of digital holography is not restricted to the visible-light regime but also at long IR wavelengths, as reported by Pelagotti *et al.*, who show that it is feasible for large objects holography using a CO_2 and a thermal camera. Simultaneous use of visible and IR illumination is used by Kakue *et al.* for the purpose of capturing surface and internal information of human tissues. On the other side of the light spectrum, Gopinathan *et al.* demonstrate imaging of microscopic objects at vacuum UV wavelength. An important part of the issue is devoted to the recent advances in digital holographic microscopy. Micó *et al.*, present a new method for recovering the complex wavefront diffracted by a sample from a set of in-line recorded holograms. An innovative application is reported by DaneshPanah *et al.*, who propose the integration of digital holographic microscopy and holographic optical tweezers to identify, control and track cells and microorganisms in three dimensions. The paper presented by Anand *et al.*, tackles the use of digital holography for studying the dynamics of the phase of micro-objects. In the context of digital holography, the implementation of compressive Fresnel holography, by Rivenson *et al.*, a survey of materials for updateable 3D display by Christenson *et al.*, or a method for wide-angle wavefront reconstruction, by Tanaka *et al.*, are also topics of great interest tackled in this Special Issue.

Other original reports include novel devices for visualization through 3D displays such as liquid crystal active glasses (by Srivastava *et al.*), head-tracking devices (by Brar *et al.*), and 3D imaging in turbid water by Cho *et al.* The paper (by Miyazaki *et al.*) is devoted to the development of a new volumetric display system and represents a progress on key topic.

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