Scanning the Issue

Special Issue on 3-D Technologies for Imaging and Display

Three-dimensional (3–D) imaging, display, and visualization are considered to be important applications of information systems in a society that is increasingly dependent on the presentation of information. There are broad applications of these technologies in computer display, communication, TV, video, entertainment, robotics, metrology, reconnaissance, defense, homeland security, healthcare, and medicine.

Ideal 3-D imaging, visualization, and display, in particular moving/dynamic scenes, are one of the goals for future technologies because of their diverse and significant applications. Developing technologies to display high quality 3-D scenes, especially dynamic scenes, is a difficult problem. The main challenges are to address resolution, depth of focus, view angle, compactness, cost, bandwidth, human factors, and real-time operation.

Attempts were made to produce stereoscopic effects in paintings even before photographic technology was fully developed. Science fiction motion pictures frequently use 3-D imaging and display to enhance special effects. Initial attempts to generate moving stereoscopic images were for movie production. Video technology is increasingly being exploited to produce moving pictures with 3-D effects. In addition, 3-D virtual reality applications are attracting great interest, and many experimental systems have been reported. Three-dimensional moving picture systems are increasingly in demand for various applications in entertainment, industry, and medicine. Some of these systems have already matured to a practical level. However, very high quality 3-D image systems still face challenges to implement.

With the rapid advances in optical display monitors, electronic/optoelectronic hardware and software technologies, many 3-D imaging and 3-D display techniques can now be implemented with commercially available off-the-shelf components and can be used for diverse commercial applications. A number of experimental 3-D moving picture systems have been proposed and developed. Depending on the characteristics of the reproduced 3-D images, they can be classified into three types: binocular, multi-view, and spatial image reproduction. Each of these is a complex technology that combines optical, electronic, display, and image sensor technologies. In addition, there are active image sensing (capture) systems such as holographic techniques which require laser illumination sources, as well as passive image capture systems such as multi view imaging approach that can operate under ambient light. These technologies are multidisciplinary and incorporate knowledge from the fields of optics, communication, optoelectronics, electronics, signal processing, and psychological science.

The overview papers in this special issue are contributed by some of the leaders in the field of 3-D imaging and display. They are intended to present fundamental ideas, theory, experiments, and applications of some of the leading 3-D techniques. In addition, they are intended to provide examples, simulations, and experimental results to illustrate the main concepts.

The paper by Okano *et al.* discuses practical issues in implementation of integral imaging systems. Son *et al.* present an overview paper on various methods and essential components of generating 3-D images. The paper by Fehn *et al.* provides an overview on recent trends in 3-D TV including an experimental 3DTV system that is based on the joint distribution of monoscopic color video and associated per-pixel depth information.

Travis *et al.* describe how to project 3-D images within inexpensive flat panels by pointing a projector into a wedge-shaped light-guide to time-multiplex a 3-D image on a large screen. Yeom *et al.* present automated optical imaging techniques for real-time 3-D visualization, identification, and monitoring of moving biological microorganizms in dynamic scenes. Eden's review focuses on selected emissive display technologies: plasma display panels, field emission and surface-conduction electron emission displays, and microcavity plasma arrays. In their paper, Hill *et al.* discuss 3-D LCDs and their applications based on parallel barrier method. The paper by Stern *et al.* provides an overview of the recent approaches and techniques developed to overcome limitations of Integral Imaging systems in terms of resolution, depth of focus, and view angle for 3-D imaging and display. Itoh *et al.* describe coherence based 3-D imaging, spectral imaging, and laser scanning microscopy.

Otsuka *et al.* present a method for 360° viewable 3-D displays based on multiple image scene projection onto a spinning screen. Frauel *et al.*'s paper reviews various applications of 3-D imaging, visualization, display, processing, encryption, and recognition using digital holographic techniques.

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Takaki's paper describes a high-density directional display to produce 3-D images by projecting a large number of directional images using directional rays.

Clearly, the subject of 3-D imaging and display is very broad and it is not possible to cover every existing approach and/or R&D activity in a single special issue. However, we hope that this issue will be useful for students, engineers, scientists, and managers who are interested in this important field. There is a large community dedicated to R&D on imaging and display systems who may benefit from learning about the advances in the rapidly evolving field of 3-D imaging and display. This issue attempts to addresses these interests by providing an overview of recent advances in 3-D imaging, display, TV, and visualization.

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