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THREE-DIMENSIONAL CAMERA SYSTEM FOR THIN THREE-DIMENSIONAL DISPLAY BASED ON THE RECONSTRUCTION OF PARALLAX RAYS

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Abstract. *We have previously proposed a thin three-dimensional (3D) display system for displaying natural images based on the reconstruction of parallax rays. In order to display a real 3D scene using an image-based rendering technique, we have also proposed a camera system that captures light ray data needed for reconstructing 3D images by reconstructing parallax rays from multiple images captured from multiple viewpoints. However, to reconstruct a 3D image of a real 3D object, many parallax images are required. In order to reduce the number of required images, we have proposed an interpolation algorithm suitable for a thin 3D display, as well as a method of estimating the minimum number of required cameras. In this paper, we describe a 3D camera system for a thin 3D display, and we present experimental results. When the distance between the proposed 3D camera system and a real 3D object was 380 mm and the depth dimension of the 3D object was 100 mm, the proposed 3D camera system, consisting of 12 cameras, can obtain sufficient 3D light ray data. Experimental results confirm that 3D images were reconstructed on the thin 3D display system from the obtained 3D light ray data.*
Keywords: Multi-camera system, Image-based rendering, Integral imaging, Three-dimensional display, Autostereoscopic display, Holographic optical element

1. **Introduction.** We have previously proposed a thin three-dimensional (3D) display system for displaying natural images based on the reconstruction of parallax rays [13,15]. Its notable feature is the ability to display natural 3D images, like holography, which are visible to multiple viewers at the same time without the need for special glasses. In the proposed ray reconstruction method, multiple rays discretely sampled from the light waves diffusely reflected at an object's surface are used for reconstructing and recording 3D images [2,4-6,10,11,17]. Figure 1(a) shows the light waves diffusely reflected at an object's surface, Figure 1(b) shows multiple rays discretely sampled from these light waves, and Figure 1(c) illustrates the reconstruction of the object displayed using the reconstructed light rays. In this display system, 3D images are formed by the intersection of discrete reconstructed parallax rays coming from the display screen. In order to display a real 3D scene by applying the principle of ray-space representation [16], which is one type of Image-Based Rendering (IBR) [1,3,16], we have proposed a camera system that captures light ray data needed for reconstructing 3D images from multiple images captured from