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SMALL CAPTURING SYSTEM OF THREE-DIMENSIONAL IMAGE USING COMPOUND OPTICS

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Abstract. *We have developed a small 3D image capturing system using compound optics. The system consists of micro lens array and an image sensor. As a micro lens array, we used GRIN lens array. It decreases a cross talk which lens-to-lens occurs on image sensor. Digital processing of the captured multiple images is used to extract the surface profile. Preliminary experiments were executed on evaluation system to verify the principles of the system and to clarify the issues related to its implementation.*
Keywords: Micro-lens, 3D processor, 3D imaging

1. **Introduction.** Many applications require an acquisition of 3D data in real-time. For example, robotics, automotive area, biometrical identification, construction, game and so on. Several approaches for non-contact distance measurement exist: a triangular surveying, an interference method and a range finder method. Each of these methods has many advantages and any disadvantage.

In the meantime, there are many studies on Integral Video-graphy (IV). IV is an autostereoscopic video image technique based on Integral Photography (IP) and is one of the 3D display techniques. As the IP needs to capture light field, two methods exist. The first, a single camera captures light field through a lens array. The second method is capturing it with a camera array. Many systems with camera arrays have developed. However, those methods have a problem that what is efficient layout.

We have developed a single camera system which consists of micro-lens array, signal separator and an image sensor. Our system is called Thin Observation Module by Bound Optics (TOMBO). Figure 1 shows a schematic diagram of TOMBO. The system composed of a micro-lens array, a separation layer and a Photo-detector array. The lens array based a single camera is not sufficient for high-density and high-resolution. To overcome this problem, TOMBO uses the digital image processing. One of this processing is super resolution. However, this system is so small for a size of micro-lens and a pitch of separation layer. So, it is a problem that misalignment occurs for assembling work. The error of alignment is one of factor affecting for the error of measurement.

In this paper, we supposed a new type TOMBO with GRIN lens array. Using GRIN lens array, the system doesn't need a separation layer. Thus, it is possible to easy for optical aliment. Also, GRIN lens is used as a detector lens of copy machine. That is to be able to take a close-up image by our system. Our study examined to be able to measure the object by prototype system and to take a colony of cell as a small sized target. In Section 2, we describe the TOMBO architecture. In Section 3, we explain the