Design and Manufacture of a Compound Eye System for 3D Imaging

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Abstract.

Digital imaging technology has been widely applied from popular consumer electronics products to aerospace applications. In the field of precision metrology, 3D digital imaging technology is indispensable in the testing and measurement of the object’s shape, profile, angular distances of industrial and scientific products from mechanical, electronics and biological fields. This paper focuses on the latest development of freeform optical technology and powerful image analysis techniques to develop a compound eye camera system so as to extract the 3D relative position coordinates of the sub-object in the field of view, and to compensate the shadow effect in the images caused by the non-uniform illumination to obtain high quality 3D images. The main objective of this paper is to design a novel compound eye system from high definition 3D digital imaging technology to achieve the realistic three-dimensional positional information of the object in both near and far fields. In the imaging process, the ultimate imaging quality is affected and limited by the resolution of the detector, the field of view, wavefront aberration, resolution of the optical imaging system and the ambient light. The novel compound eye system to be designed consists of two essential modules: the compound eye optical imaging module and the image analysis software module. The first one is the optical imaging module with compound eye optical elements with other secondary optical lenses, while the other one is the image analysis module. By combining the above optical hardware with the image analysis software, the relative position information of the sub-objects in the picture and the lighting condition of the environment can be deduced accurately.