Resolution analysis of N-ocular imaging systems with lens characteristics

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Various types of 3D imaging systems have been analyzed using ray optics and diffraction optics [1-3]. Recently, an analysis method to compare the system performance of N-ocular imaging systems under equally-constrained resources was proposed because the 3D resolutions is dependent on several factors such as the number of sensors, the pixel size, imaging optics, and so on [3]. In this analysis, however, the fact that the imaging lenses in front of sensors produce the defocusing effect according to the object distance was ignored. This may prevent the system analysis for a practical *N*-ocular imaging system.

In this paper, we propose an improved framework to evaluate the performance of *N*-ocular imaging systems by considering the defocusing effect of the imaging lens in the sensor. The analysis is based on two point source resolution criteria using ray projection model from images sensors. The defocusing effect according to the position of point sources is introduced to calculate the depth resolution. To show the usefulness of the proposed framework, the Monte Carlo simulations are carried out and the experimental results about depth resolution are presented.

In general, the imaging lens used in the image sensor has the defocusing effect according to the distance of 3D object as shown in Fig. 1 [4]. With this defocusing effect, we calculate the depth resolution. To do so, we utilize two point sources resolution criteria with spatial ray back-projection from image sensors to reconstruction plane [3]. Figure 2(a) shows the simulation results for different distances of the first point source according to the number of cameras for depth resolution. As the number of cameras increases, the depth resolution increases. Figure 2(b) shows the results according to the distance of the first point sources. It is seen that the minimum depth resolution was obtained at z= 12,000 mm because the CDP is 12,000 mm in this experiment. As the distance of the first point source gets more out of CDP, the depth resolution is worse.

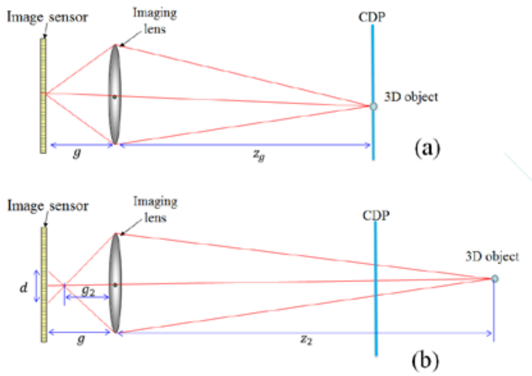

Fig. 1 Ray geometry of the imaging lens
(a) point source is located at CDP
(b) point source is out of CDP

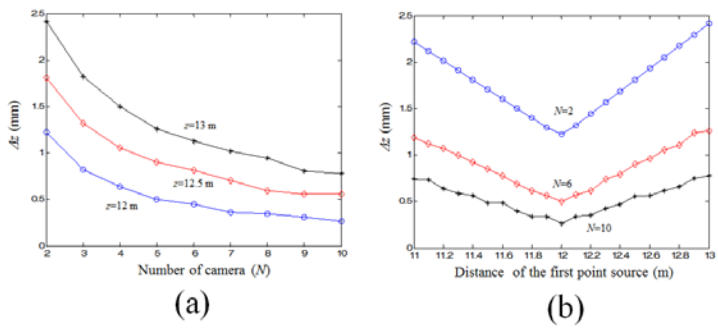

Fig. 2 Simulation results for (a) number of camera
(b) distance of the point source

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