Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 29-30, 2015

Sampling Number Effects in 2D and Range Imaging of Range-gated Acquisition

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1. Introduction

Image acquiring in a monitoring area of nuclear industry is an important function for safety inspection and preparing appropriate control plans. Thus, visualization technique to monitor devices and facilities from bleary smoke environments, such as the places of a fire and detonation, is essential.

Widely used conventional passive vision systems can't acquire image information when the illumination light is blocked by disturbance airborne particles, such as smoke, fog, dust. Also, the image captured on a sensor can be blurred and dimmed by the distortion of illumination light.

To overcome the non-visualization problem caused by airborne obstacle particles, vision systems should have extra-functions, such as active illumination lightening through disturbance airborne particles. One of these powerful active vision systems is a range-gated imaging system. The vision system based on the range-gated imaging system can acquire image data from raining or smoking environments.

Range-gated imaging (RGI) is a direct active visualization technique using a highly sensitive image sensor and a high intensity illuminant [1]. Currently, the range-gated imaging technique providing 2D and 3D images is one of emerging active vision technologies [2-3]. The range-gated imaging system gets vision information by summing time sliced vision images. In the RGI system, a high intensity illuminant illuminates for ultra-short time and a highly sensitive image sensor is gated by ultra-short exposure time to only get the illumination light. Here, the illuminant illuminates objects by flashing strong light through airborne disturbance particles. Thus, in contrast to passive conventional vision systems, the RGI active vision technology robust for low-visibility environments.

In this paper, we analyzed the number effects of sampling images for making a 2D image and a range image from acquired RGI images.

2. Imaging Experiments for Foggy Objects

Visualization experiments are carried out for an unseen foggy object where the fog depth of the object is 65 cm and the visual range is about 48 cm. Acquired 2D images from acquired 30, 20, 10 and 5 RGI images are compared. The 2D images acquired from 30, 20, 10 and 5 RGI images are shown in from Fig. 1 to Fig. 4.

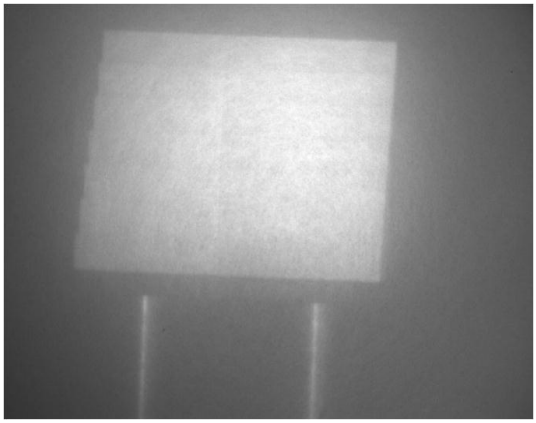

Fig. 1. 2D image acquired from 30 RGI images

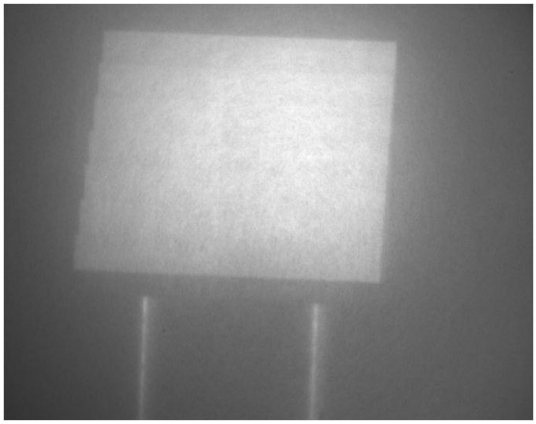

Fig. 2. 2D image acquired from 20 RGI images

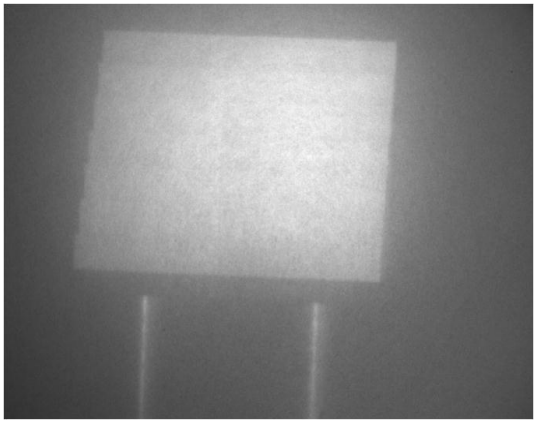

Fig. 3. 2D image acquired from 10 RGI images

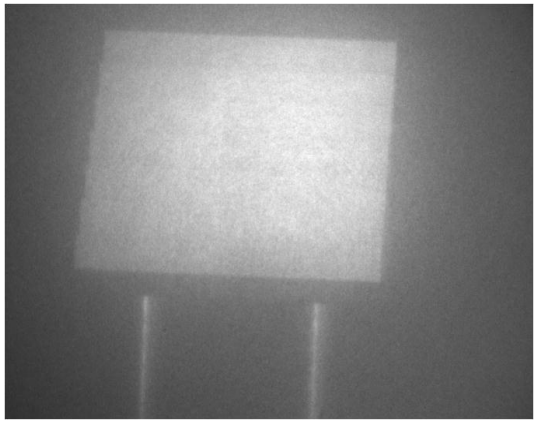

Fig. 4. 2D image acquired from 5 RGI images

Here, the starting and ending acquisition range distances are all the same in the used RGI images. As we can see, the qualities of 2D images are all similar. It means that 2D image quality is not much depended on the number of RGI images but on the extraction efficient of RGI images.

3D range images acquired from 30, 20, 10 and 5 RGI images are shown from Fig. 5 to Fig. 8. Here, we can see that image quality is improved in proportion to the number of RGI images.

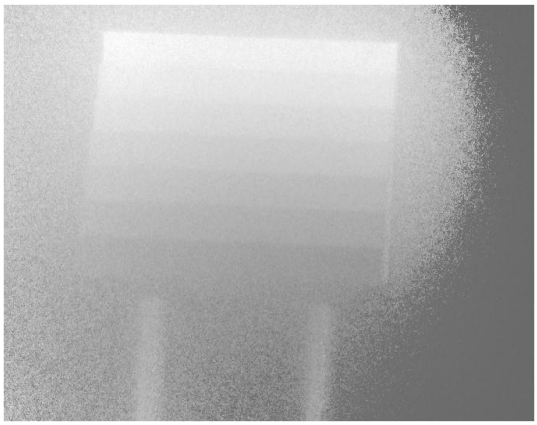

Fig. 5. Range image acquired from 30 RGI images

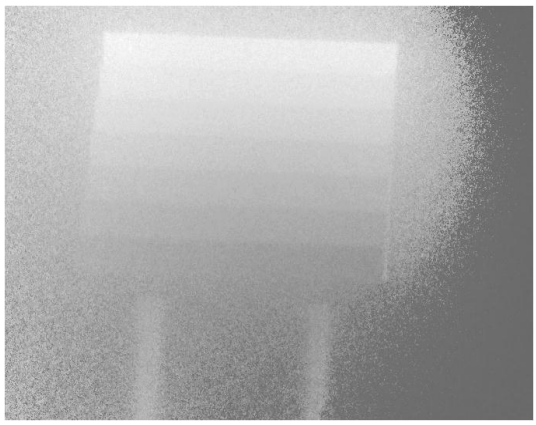

Fig. 6. Range image acquired from 20 RGI images

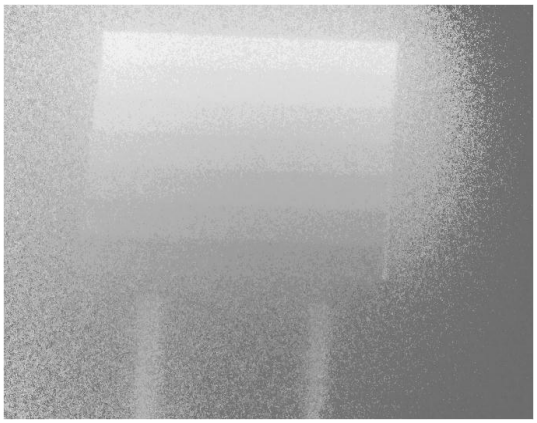

Fig. 7. Range image acquired from 10 RGI images

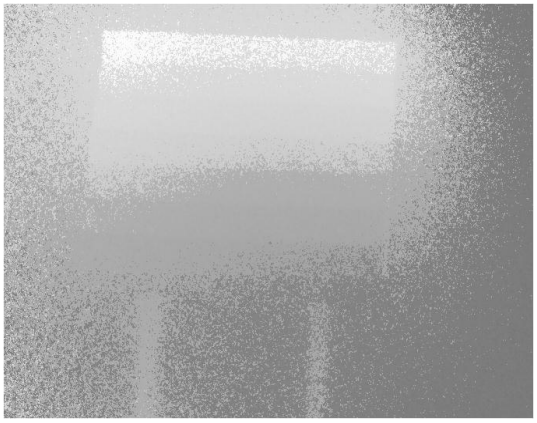

Fig. 8. Range image acquired from 5 RGI images

3. Conclusions

We analyzed the number effects of RGI images for making a 2D image and a range image using a RGI vision system. As the results, 2D image quality was not much depended on the number of sampling images but on how much well extract efficient RGI images. But, the number of RGI images was important for making a range image because range image quality was proportional to the number of RGI images.

REFERENCES

[1] Gillespie, L. F., "Apparent illumination as a function of range in gated, laser night-viewing systems," *JOSA* **56**, 883–887 (1966).
[2] Steingold, H. and Strauch, R. E., "Backscatter effects in active night vision systems," *Appl. Opt.* **8**, 147–154, (1969).
[3] Digger, R. G., Vollmerhausen, R. H., Devitt, N., Halfort, C., and Barnard, K. J., "Impact of speckle on laser range-gated shortwave infrared imaging system target identification performance," *Opt. Eng.* **43**, 738–746 (2003).