A Study on Measurement of Surface Shape by Combining Laser and Photogrammetry Techniques

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I. Introduction

Laser scanning and photogrammetry methods are the methods to obtain the surface point cloud of an object. Laser scanning can measure the actual size, but some missing spots might appear if the laser does not reach the object surface. In contrast, photogrammetry cannot measure the actual size of an object, but missing spots are less likely to appear. By using laser-scanned point clouds and photogrammetric ones together, it will be possible that point clouds of the actual size will be obtained without any missing surface spots. However, it takes time and effort to perform laser scanning and photogrammetry and synthesize the obtained point clouds.

Therefore this paper proposes a method that can automatically measure laser scanning and photogrammetry to improve the efficiency of actual-size point cloud acquisition with actual size without missing spots. To confirm the efficiency of our method, the surfaces of oysters are measured as an example. As the result, point clouds without missing spots are obtained.

II. Related Works

A device with laser sensors that can automatically measure numerous objects at once has been developed [1]. The laser measuring device [1] has four laser sensors to cover 360 degrees around the object to be measured.

However, the laser sensor is so expensive that the manufacturing cost will be high if four units are installed. To avoid this, this paper proposes measurement for which only one laser sensor is placed on the top to reduce the manufacturing cost.

Each point cloud measured by laser scanning and photogrammetry is synthesized using the Scaling ICP (SICP) algorithm [2].

III. Proposed Method

The measuring device is constructed with multiple web cameras placed on the arm of the laser scanning device. The object to be measured is placed on the glass table. As shown in Fig. 1, The blue square is the laser sensor and the red circles are web cameras. The laser sensor is located on the top side of the arm. For photogrammetry, five web cameras are placed on the arm so that the upper surface of the object can be measured by the photogrammetry technique. Since photogrammetric images reflect the equipment under the glass table, a green partition sheet is pasted under the glass table as shown in Fig. 1. Then the green partition sheet is removed and the images of the object's backside surface are manually obtained by a digital camera. The obtained images are applied to create the point cloud of the backside surface by the photogrammetry technique.

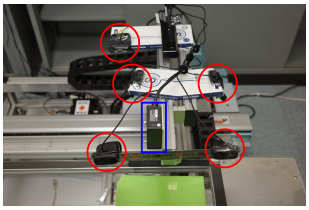

Fig. 1. Web camera attached to the arm

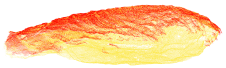

Fig. 2. Synthesis result

After noises are removed from the point clouds, the initial position is determined by manual operation. Finally, the SICP algorithm is applied to refine the position.

IV. Experimental Results

To verify our method, an oyster shell is measured as an example. Figure 2 is the synthesized result, where the red point cloud is the one obtained by laser scanning and the yellow point cloud is the one by photogrammetry. As shown in Fig. 2, our method enabled to the creation of complete surfaces with point clouds.

V. Conclusion

In this study, a system was developed to automatically measure laser scanning and photogrammetry. In the future, web cameras will be placed on the bottom side for more effective operations.

References

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