New approach for measuring 3D space by using Advanced SURF Algorithm

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1. Introduction

Mankind has been fighting against all about disaster for a long time. In the process of overcoming disaster, human has been researched for minimizing the damage and developed the skills fop disaster forecasting. The nuclear disasters compared to natural disaster create a more extreme condition for analyzing and evaluating.

In this paper, measuring 3D space and modeling was studied by simple pictures in case of small sand dune. The suggested method can be used for the acquisition of spatial information by robot at the disaster area. As a result, these data are helpful for identify the damaged part, degree of damage and determination of recovery sequences.

2. Method and Result

In this paper, computer vision matching method and photogrammetry was studied.

2.1 Photogrammetry

In this study, method of measuring 3-D geospatial information is close-range photogrammetry. Images are all different location and angle. And Fig.1 shows 3-D geospatial information method by photo Image.

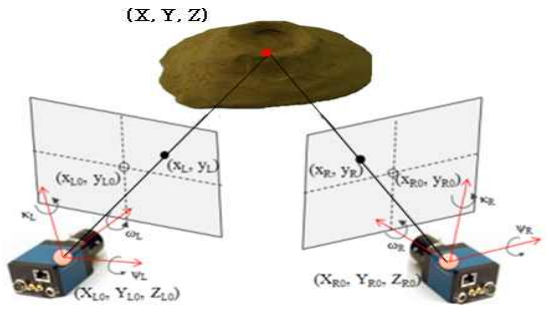

Fig. 1. Close-range photogrammetry by photo image

In the Left camera of Fig 1, it makes epipolar condition between Image coordinate of survey point (X_L, Y_L) and 3-D absolute coordinate of calculation point (X,Y,Z). And equation is following (1) and (2).

Thus we can make 2 equations include 3 parameters of 3-D coordinate survey point (X, Y, Z) if we measure image coordinate. And right side is so on.

$$X_L - X_{L0} = -C_x \frac{m_{11}(X - X_{L0}) + m_{12}(Y - Y_{L0}) + m_{13}(Z - Z_{L0})}{m_{31}(X - X_{L0}) + m_{32}(X - X_{L0}) + m_{33}(X - X_{L0})}$$

(1)

$$Y_L - Y_{L0} = -C_y \frac{m_{21}(X - X_{L0}) + m_{22}(Y - Y_{L0}) + m_{23}(Z - Z_{L0})}{m_{31}(X - X_{L0}) + m_{32}(X - X_{L0}) + m_{33}(X - X_{L0})}$$

(2)

2.2 Computer vision matching

In this study, Image matching method for calculating coordinate of matching point is SURF descriptor extraction algorithm. Also we develop Advanced matching method consist of epipolar line filtering and descriptor matching by homography transform.

First of all, we process angle correction of each different image through homography transform. Because SURF algorithm has a weak point which the more angle of each image, the less matching ratio causing sensitivity of angle.

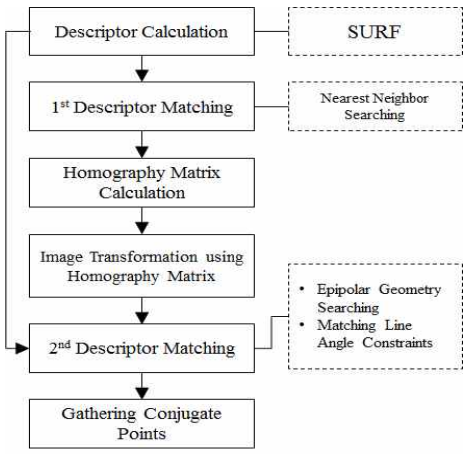

Fig. 2. Process of advanced SURF algorithm

Also using epipolar line filtering and angle of matching line filtering, it process second matching. In case of general descriptor matching, it works comparison with each descriptor of Image. It is not only

take more processing time but falling-off in accuracy of matching. Because it processing all of descriptor.

In this paper, we are increasing speed and accuracy of matching by following steps for supplement weakness. First we make epipolar line which linked center point of descriptor. And make buffer considering descriptor size, find matching point only buffer area.

2.3 Test and Result

Test object of research is artificial structure made by clay. Object is photographed by SONY NEX-5 and 6 Images are acquired by 10 degree.

As shown Fig .3 Based on obtained image we revise rotation angle by homography transform and delete miss match point by epipolar line filtering.

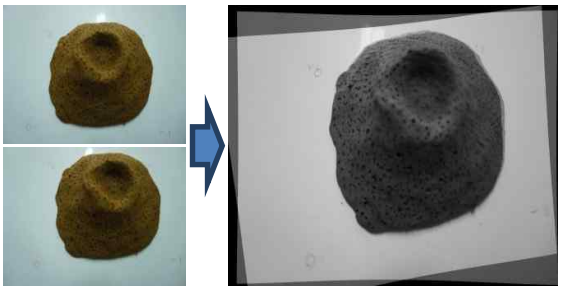

Fig. 3. Homography transform of image

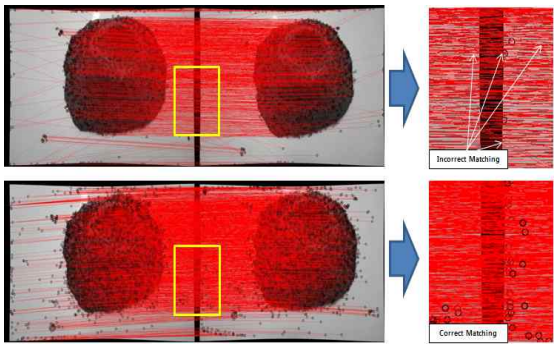

Fig. 4. Match accuracy analysis by epipolar line filtering
(Top: before filtering, Bottom: after filtering)

As shown Fig .4 we can find a lot of diagonal miss match point if not process epipolar line filtering. On the other hand in case of epipolar line filtering, we can see most of diagonal miss match points are deleted.

Shape of extracting 3-D point cloud is Fig .5

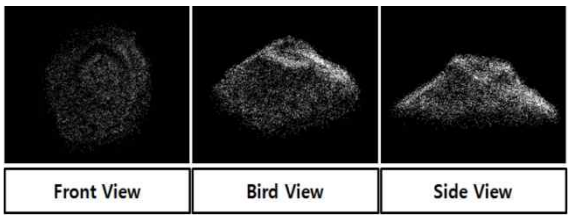

Fig. 5. 3-D point cloud

3. Conclusion

In this study we are improving computer vision algorithm for 3-D geospatial information measurement. And confirm by test.

First, we can get noticeable improvement of 3-D geospatial information result by SURF algorithm and photogrammetry surveying.

Second, we can confirm not only decrease algorithm running time, but also increase matching points through epipolar line filtering.

From the study, we are extracting 3-D model by open source algorithm and delete miss match point by filtering method. However on characteristic of SURF algorithm, it can't find match point if structure don't have strong feature. So we will need more study about find feature point if structure don't have strong feature.

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