CETRA 2016

4th International Conference on Road and Rail Infrastructure
23-25 May 2016, Šibenik, Croatia

Road and Rail Infrastructure IV

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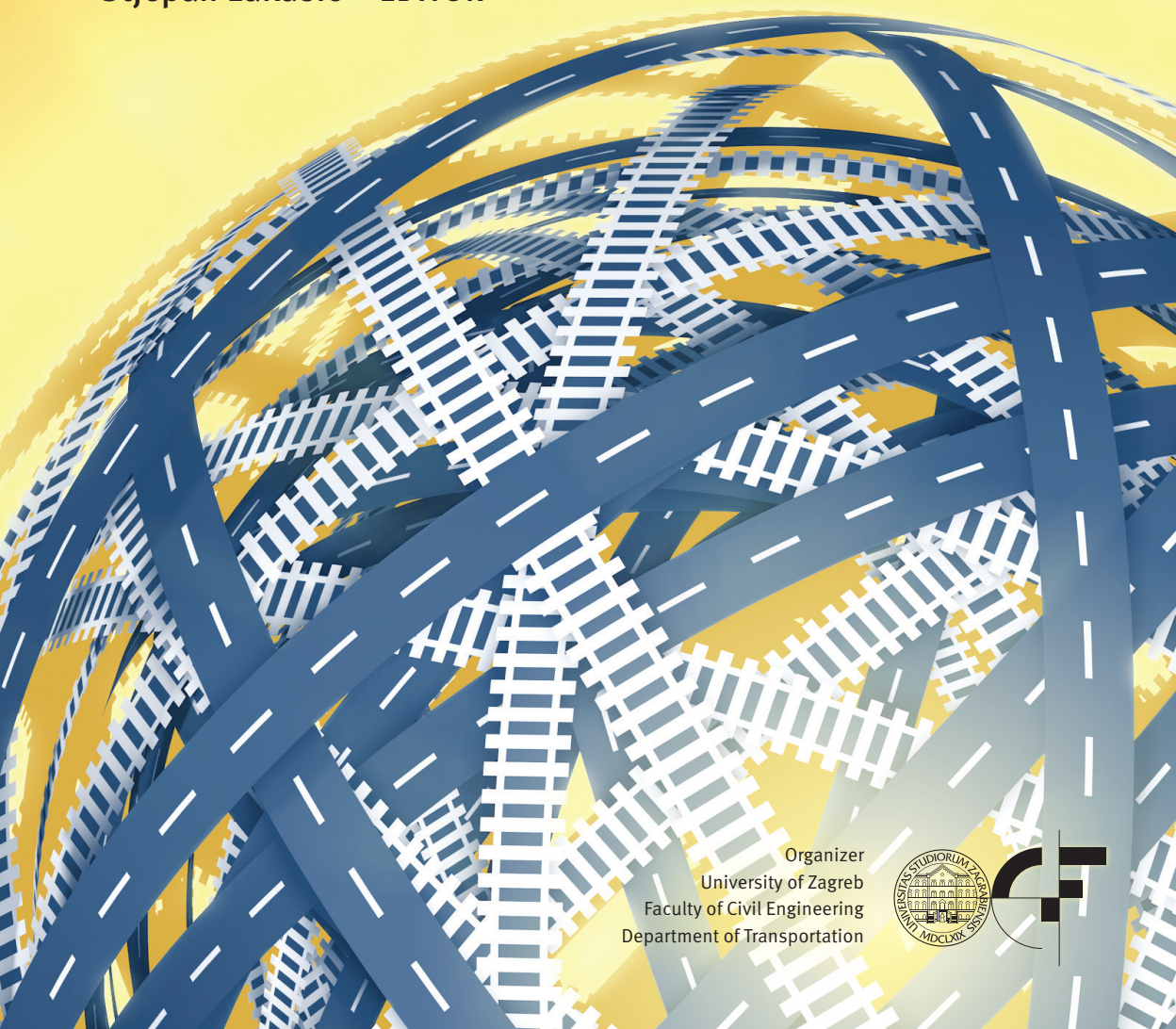

Organizer
University of Zagreb
Faculty of Civil Engineering
Department of Transportation

CETRA2016
4th International Conference on Road and Rail Infrastructure
23–25 May 2016, Šibenik, Croatia

TITLE
Road and Rail Infrastructure IV, Proceedings of the Conference CETRA 2016

EDITED BY
Stjepan Lakušić

ISSN
1848-9850

PUBLISHED BY
Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia

DESIGN, LAYOUT & COVER PAGE
minimum d.o.o.
Marko Uremović · Matej Korlaet

PRINTED IN ZAGREB, CROATIA BY
"Tiskara Zelina", May 2016

COPIES
400

Zagreb, May 2016.

Proceedings of the
4th International Conference on Road and Rail Infrastructures – CETRA 2016
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EVALUATION OF INFRASTRUCTURE CONDITIONS BY 3D MODEL USING DRONE

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Abstract

Recently, a fantastic view and a bird view is easy to be taken a movie by the drone. Especially, the 3D models can be created using the movie which is taken by the drone easily. This time, the created 3D models of the road are analyzed multilaterally in this study. The purpose of this study is to evaluate a safety of the road because 3D model is able to express structures on the road, slopes and fillings. At first, two situations road are taken the movies by the drone. One of two is slopes and fillings on the road. The other is a bridge above the road. The ways of taking the movie are an overall image of the pickup road and limiting a photographing range. The filmed movies convert 3D models by agisoft photoscan. It depends on time of movie, it takes more than seven hours to create high quality 3D model. As a result of this study, it became clear that unusual point and changes out of sight was discovered by the 3D model which is structure on the road, slopes and fillings. An overall image of the pickup road of the 3D model which is compared regularly can be perceived changes and the model which is limiting a photographing range can be analyzed details. Also it is possible that taken difference between the current 3D model and the past that can be offered an insight into any signs. In this way, the 3D model is useful to evaluate a safety. And it is one of the easy ways to survey and inspect the road.

Keyword: drone, 3D models, agisoft photoscan, inspect

1 Intoroduction

These days, the drone is able to be used easily for anyone. By flying it can film a fantastic view from the air and get a dramatic movie. The drone's (use PAHNTOM3 Professional) features are a stable hovering function and loading the 4K image quality of a camera. Since it is no influence of wind, it is possible to easily operate. Also it can fly more advanced one hundred meters, be safely operated until about one kilometer away.
The drone is expected to use infrastructure inspection such as bridges and structures, since it can shoot out of sight usually. Most of the infrastructure equipment in Japan is damaged such as cracks and distortion by aging [1],[2]. Therefore, it is essential to construct ways of efficient inspection and evaluation. The purpose of this study is examination of construction about how to extract the degradation by the drone and evaluation of itself. With this, it is necessary to meet the required performance about inspection of infrastructure equipment. It is safety for the inspection maintenance. It is easily and sensuous ways. It is efficiency of being able to check a lot of infrastructure equipment in less time. It is correct and economic. These required performance are necessary to achieve for inspection of infrastructure henceforth. In this study, there is an aim to verify whether a practical way while satisfying the performance. In order to build technique, the data of bridge girder and structure wall set to target mainly. Since damage, such as cracks can be determined fundamentally by eye, taking difference

between the current condition and the past that can help to grasp where there is unusual point. In this study, damage of interest handle only cracks which are important and representative for inspection of concrete structure. In terms of cracks, they are small to large things which are impact on the structure. Althogh large cracks can be discriminated by eye, small things are difficult to capture in the shooting of drone. In case of shooting closely, there is a risk of contact with the structure. The drone is a manned operation in the present circumstances, and some risk due to human error is fraught surely. As outlook, if the drone can set a flying route, a flying speed and shooting angle, the target structure can be observed in the same every time and be compared accurately. But the photographing by the drone is a manned operation, an error of data occurs. Also the same data does not get in case of canged shooting date and shooting time in the same object. So it is necessary to consider it from now on.
Various previous studies are refered to this study [3],[4]. For example, there are many ways to automatically extract the cracks. But a different point of previous studies in this study extracts deterioration by taking different between images. As outlook, it is a goal to extract by taking different between 3D models. Up to now, there is a way to recognize deterioration in automatic. The feature of this study is a recognization how degree of progress of damage by subtraction. Furthermore, this study is a trial method to establish extraction ways by taking different between 3D models.

2 Data

2.1 Research data

The data of this study is 3D models which created using SfM technology based on video taken by drone. Actually, the target is 2D, that is dealing with the image. The software called agisoft photoscan is used for data creation. The flow of data creation is shown in figure 1. 3D models are necessary to consider shooting methods and shooting points for the required inspection point. For example, cracks of bridge piers should be taken a video closer. Also, the shooting from a variety of viewpoint is important in order to express the rilief such as slope and filling.

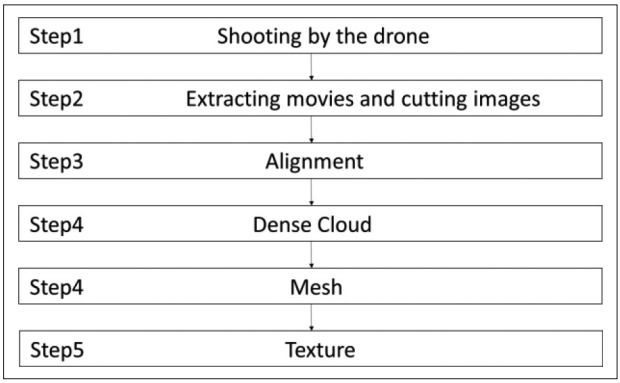

Figure 1 The flow of data creation

2.2 Research method

Figure 2 shows the verification procedure of data. The configuration of the procedure is a five stage:

- 3D models of target structure are created according to Figure 1. They are evaluated whether they can be made accurate, the shooting repeats to get high accuracy of data if there is an

unclear part. To verify that the deterioration such as cracks are incorporated in accurately in the 3D models.
- The obtained data processes the 3D to 2D. It is careful so that the compared images must be considered to make the same quality.
- To take different between the current images and the past that are compared. Part that does not overlap the image is a feature point that degradation is obtained by the subtract.
- To verify whether the deterioration can be extracted.
- The obtained result is evaluated whether that is significance.

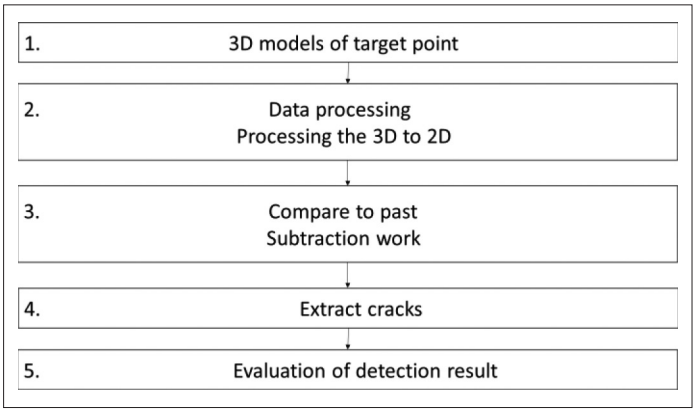

Figure 2 Verification procedure

3 Analysis and result

3.1 Data creation

The images of analysis show in Figure 3. It is asuumed to be two patterns. (a) in Figure 3 is a wholesome wall with no pseudo damages. (b) in Figure 3 is a unwholesome wall with pseudo damages. In this study, pseudo-deterioration is deliberrately lager than the real that for verification.

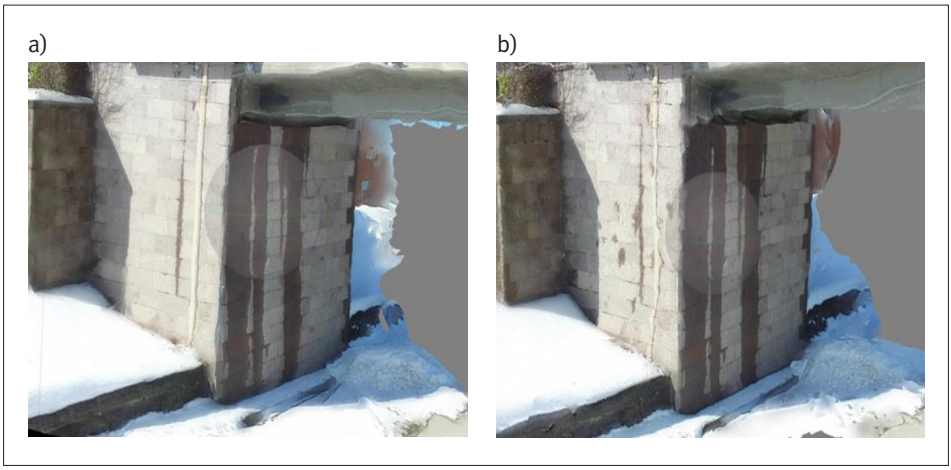

Figure 3 The target model images of verification

Figure 4 shows the shooting route to get the target data.The point of interest is pier in bridge of kanazawa university. The shooting date is January 26, 2016 by PAHNTOM3 Professional. The video time is about 1 minute. By photographing the 2 pattern as (a) and (b). The shooting accuracy is relatively well, sufficient data is obtained.

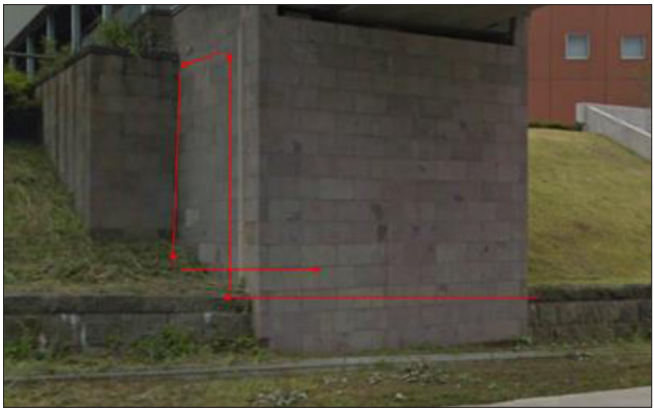

Figure 4 The shooting route

3.2 Analysis of verification

With Figure 3, it is cariied out subtraction processing by photoshop. Figure 5 shows a image after the subtraction. The black portions of the image are dyed black so that RGB values are the same. This corresponds to portions with no changes. Also, white portions happens some sort of changes. This shows that RGB values are not identical.

Figure 5 A image after the subtraction processing

Figure 6 shows that it is an enlarged view of extracted changes. The points which are surrounded by red circles correspond to the extracted pseudo-degradation and damage. This subtraction processing shows how about the extent of the damage is in progress. But it is not able to extract the degradation only because it detects the distortion of the data itself. Also, the detected damages are much larger than the real damages in this time, it is necessary to extract actual cracks from now on.

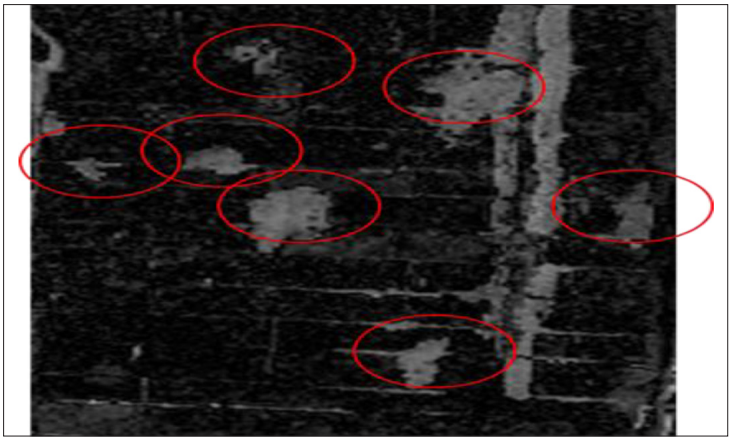

Figure 6 The extracted changes and distortion of data itself

4 Conclusion

In this research, although it succeeded in extracting the pseudo deterioration and damage, the result remains some challenges whether this method can be applicated to actual cracks. The future prospects are expected to extract deterioration such as cracks actualy by the automatic flying drone and compare 3D models. It is also necessary to consider the subdividing of flow so that it can be applied to an actual inspection.

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