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Identification of Defects and Hazards in Structures Based on the Point Cloud Using the OptD Method

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1 Introduction

Terrestrial laser scanning (TLS) has been widely used for many years, especially when creating various types of architectural documentation. It can be also used to monitor various types of objects for example: buildings (Przyborski and Tysiac 2018), forests (Liang X. *et al*.,2016), power lines (Maikainen, L. *et al*., 2016) etc. TLS allows to collect a large dataset saved as a three-dimensional coordinates and intensity parameter. Having access to this type of data, one can conduct various types of analyses, simulations, calculations, etc. Building objects are subject of the influence of various factors that affect their technical condition. Every day various types of atmospheric conditions and weather phenomena occurs (wind, snow, rain, sun) sometimes there are also violent phenomena that are usually extreme and desructive (hurricanes, floods, earthquakes, etc.). At the time of estimating losses, calculating the costs of repair, and then making decisions about the method of restoration, a helpful tool can be laser scanning: terrestrial, airborne or mobile, depending on the character of the object and the size of the disaster. The paper presents an identification of defects and hazards in structures based on the point cloud using the OptD reduction method.

2 OptD Method

The object scanned with high resolution results a point cloud that is a huge data set. Usually its original size is difficult to process because it requires high performance hardware. The solution to this problem is to reduce the point cloud by eliminating some points. Commercial software usually contain basic methods of data reduction, *e.g*. random or with an assumed interval, etc. The disadvantage of doing so is that as a result of random reduction one can lose many valuable points associated with the geometrical features of the object. The proposal presented in this paper is to use the OptD method during data processing.

The OptD method has been already presented in papers (Blaszczak-Bak, 2016). This method was developed to reduce the dataset without losing the information that is necessary for the correct implementation of the planned task. In addition, due to the appropriate reduction of points, it is possible to specify areas that are characterized by the largest defect. It can be observed in Figure 2.

3 Defects Identification Based on the TLS Point Cloud Using the OptD Method

The measured object is a fragment of a retaining wall that supports the escarpment. This wall suffered because of a heavy rain which eroded the area above the escarpment, and then the ground and water flowed down destroying the retaining wall. Besides, some fragments of the wall are destroyed because of its age. Figure 1 shows the fragments of the destroyed area.

Figure 1. The photo of destoyed wall.

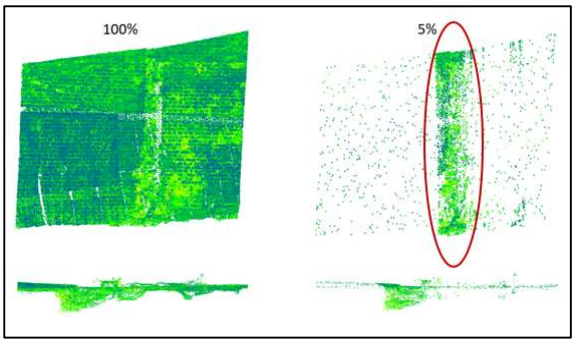

Figure 2. The input point cloud (100 %) and reduced point cloud (5%).

Figure 2 presents the input (100%) point cloud and reduced point cloud. On the input point cloud it is difficullt to observe this part of the wall that is dameged the most. Reducing the data set by 95% it is possible observe the area that is characterized by the largest defects in the wall.

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