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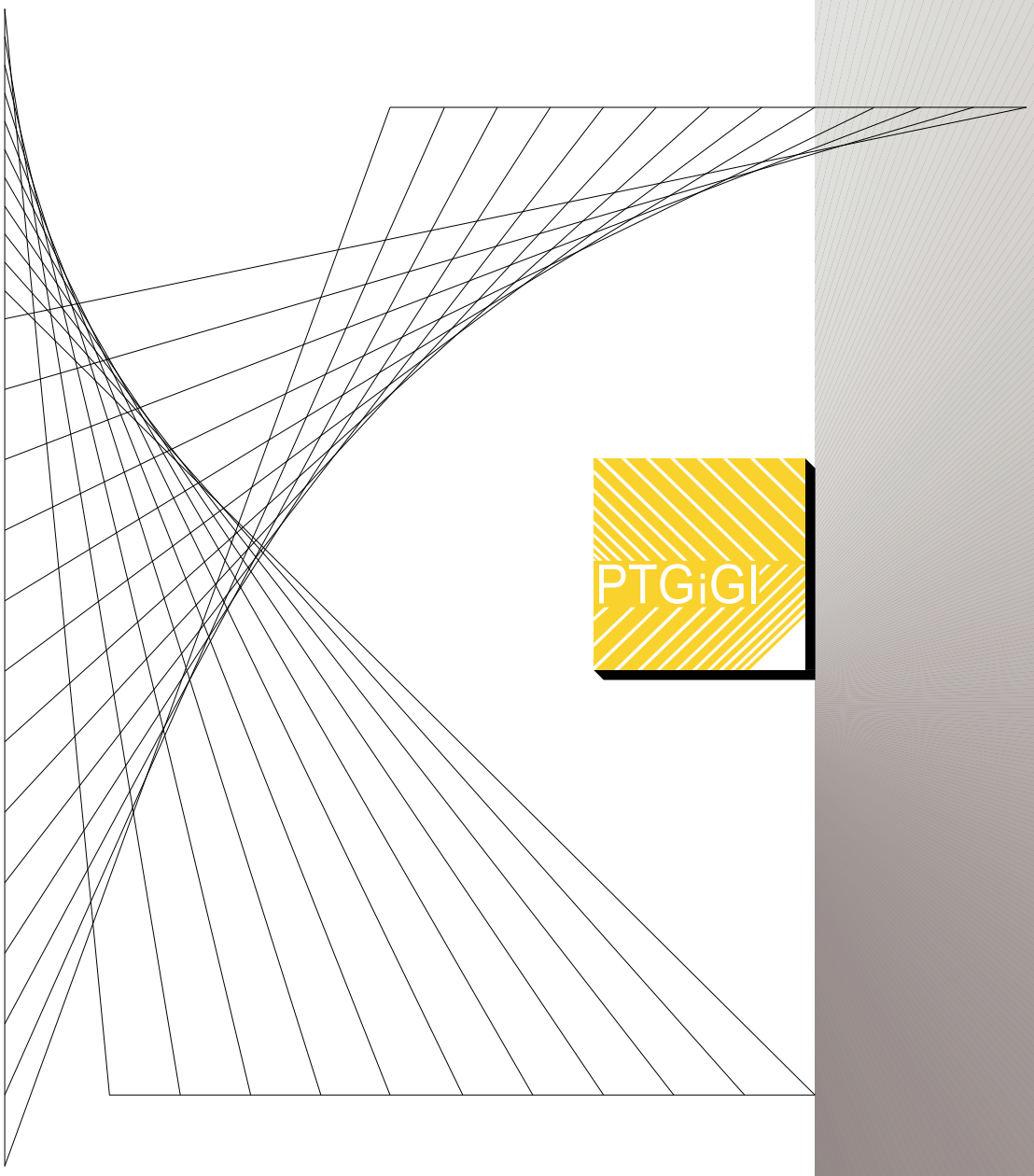

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APPLICATION OF TERRESTRIAL LASER SCANNING DATA IN DEVELOPING A 3D MODEL

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Abstract. The publication includes the measurement of the small architecture object by means of terrestrial laser scanning. In addition, the primary goal is to visualize the object in the form of a 3D model. The 3D model was made on the basis of a unified point cloud with a resolution of 2mm in MicroStation V8i (SelectSeries 3). The point cloud, on the other hand, consisted of 7 scans that represented 7 uniformly distributed around and in the middle of the architectural site of the sites. To connect the scans were used binding points - so-called reference balls with a matt and white surface. The Leica Cyclone program orientated the scans and created an alignment report. The model created in this way was unified and the file was exported with the help of special tools until it received the file: ".pod". Based on this file, a 3D model was created. It is also impossible to skip procedures such as texturing, visualization, which made it possible to present an interesting model of a selected object. The object that was chosen was a wooden bridge with benches and a gazebo located in the southwestern part of Dębnicki Park at Praska Street in the district of VIII Dębniki in Krakow.

Keywords: Terrestial Laser Scanning (TLS), Leica Cyclone, 3D modeling

1 Introduction

Terrestial Laser Scanning is slowly becoming a technology known to architects and conservators. It is used mainly as a tool for collecting data for documentation necessary to reproduce the actual state of the object before renovation. Museums are increasingly benefiting from the development of contemporary technology. They try to get people interested in learning history in a different way. Educational portals and virtual museums require modern, high-quality visual materials (3D models, virtual tours, animations, etc.) supplemented with descriptive content or audio comments [1].

2 The subject of the study and a type of scanner

The subject of the study was a small architecture object located in the Dębnicki Park in Krakow (Fig.1). The park is located in the VIII Dębniki district, it was founded in 2003. therefore we can consider it as one of the youngest parks in the city. Away from the center of approximately 2 km along a straight line and 4.1 km moving along the road from Dietla St.

The selected architectural object was scanned using the Leica ScanStation P40 measuring instrument. The measurement covered the outer contour of the object as well as the internal by performing a scan in the center of the object. The total number of measuring stations included in the field was 7 (Fig.2).

Figure 1: Measuring object located in Dębnicki Park

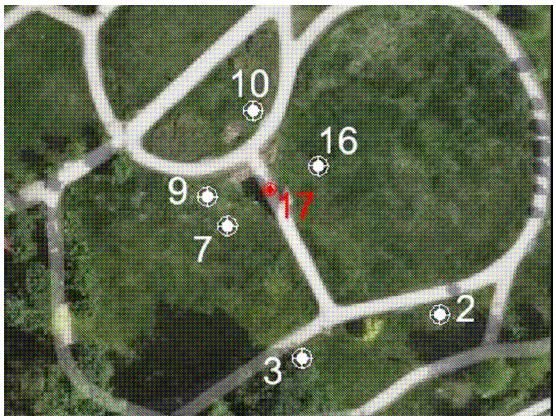

Figure 2: The location of measuring stations on the background of the selected architectural object (the position inside the facility is marked in red)

3 The process of scanning the object

Scanning for 6 stations was performed with a resolution of Hz: 0.002 m, V: 0.002 m for distance 20.000m. In turn, for stand 17 (inside the building) with Hx resolution: 0.002 m, V: 0.002 m at a distance of 5.000 m.

The so-called binding points were used to orient the scans. reference balls with a matt, white surface (Fig.3). They are arranged so that it is possible to combine scans based on at least three balls. "The tie points should be evenly spaced in the largest possible area of common coverage of scans" [2].

In order to process the point cloud, a measurement file had to be implemented the software used. Then, the scan orientation was started, which aims to combine into a single cloud individual clouds of points obtained from individual measuring positions, using the mapping of the same target plates or natural points scanned from different positions" [3].

In the case of the performed measurement, the same binding points were used, which were the reference balls. In the Leica Cyclone process scanning connections are done automatically, which significantly speeds up the work (Constraint - Auto-Add Constraints (Target ID Only)). The last step is to use the Registration - Register main menu. This process involves combining all scans into one without the use of target plates at the same points. In this process it is possible to reject connections by: switching off such a connection, which is burdened with a significant error. Orientations were made for enabled connections with an average error of 0.001m. The result is extremely satisfying due to the difficulty of fitting the sphere center into the sphere and the unambiguous identification of the same point on different scans. Registration and creation of ModelSpace and ModelSpace View is a oriented cloud of points with measurement noise. Measuring noise is represented by points located on the edge and within the object - they are unnecessary and should be removed. The last stage before proceeding with the export is to perform unit point cloud fiction (Scan World - ModelSpace). This process consists in determining the distance between neighboring points and implementing it into the created point cloud. After unification of the cloud, the export began, the main menu was selected: File-Export, search location saved. Format selected: Text-PTS Format (.pts). MicroStation V8i (SelectSeries3) does not read such a file, so Bentley Point Tools POD was used Creator, which allows you to create a POD file, which is the basis for modeling in MicroStation.

4 Creating a 3D model with textures in MicroStation V8i

"The MicroStation family of products provides comprehensive capabilities for precise browsing, modeling, documenting and visualizing the rich in information on 2D and 3D projects of all types and on any scale by specialists in every field and for infrastructure projects of any type" [4]. On the attached point cloud, object modeling began. In the next stage, you had to declare the coordinate system in 1 of 4 viewports using coordinates auxiliary by defining PUW by points. It was necessary to reach the point cloud and determine the X axis by indicating the edge on 1 plane in the cloud, then the process was repeated, but for the Y axis. The Z axis is generated automatically. Finally, the layout was set on all views (Fig.4). It is quite a tedious and time-consuming process, due to the need to set such a system for each modeled object. This process cannot be accelerated in any way and must be done manually.

Figure 3: Location of the reference ball during the measurement

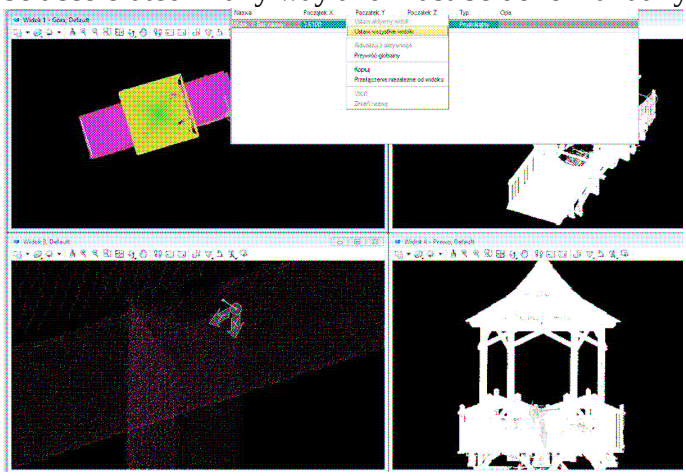

Figure 4: The method of inserting a coordinate system on an object

The next stage was setting the depth and using the spatial notch by indicating the plane that intersects the cloud of points at a given height. This plane must be drawn earlier at the height of interest to us. This process facilitates and improves work when modeling e.g. a bridge, elements that are not associated with it are turned off by this bounding plane.

The first element that was plotted was the sternum, was modeled using the R3 palette (Fig. 5) - the body by pulling along, preceded by drawing the contour of the sternum base. If an error was made, correction could be made by using T2- Modify body component. This palette lets you modify the entire solid, plane, edge and vertex. The solid is created by extruding a plane along a defined linear element - path (Q2 - place arc).

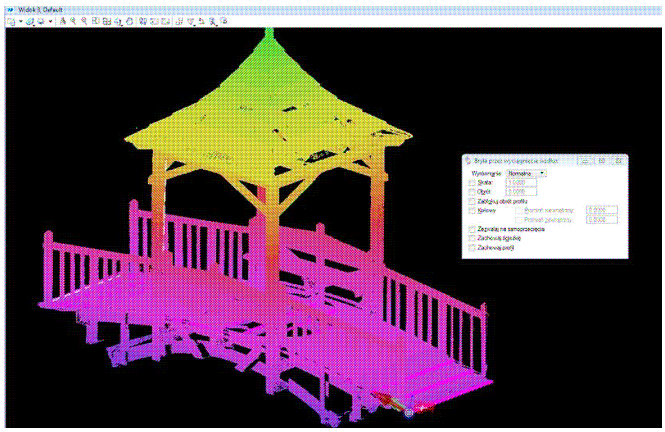

Figure 5: How to create a solid by extruding along a path

Using tool R1 (solid by extrusion), cuboids and straight lines were created solids including drawing on solid (T1) or by trimming elements above cut solids (T10) located with the tool. In turn, palettes: E1 (cuboid), R1, T1 (draw on a block), T5 (thin-walled block), were necessary when creating the roof. On the second figure was drawn in a cuboid and the slope thickness was defined using T5 roof. This operation was repeated and another block was drawn. Connected solids through tool T7 (creating the sum of solids). The last step was to use T2 to modify it upper edges so that the whole block reflects the shape of the roof. The above activities enabled the creation of a 3D model of the architectural object located in the Park Dębnicki. The final effect of solid modeling is shown in the figures (Fig.6,7,8,9).

Figure 6: 3D model - front view (display mode: smooth modeling)

Figure 7: 3D model - front view (display mode: skeleton)

Figure 8: 3D model - top view (display mode: shadows illustration)

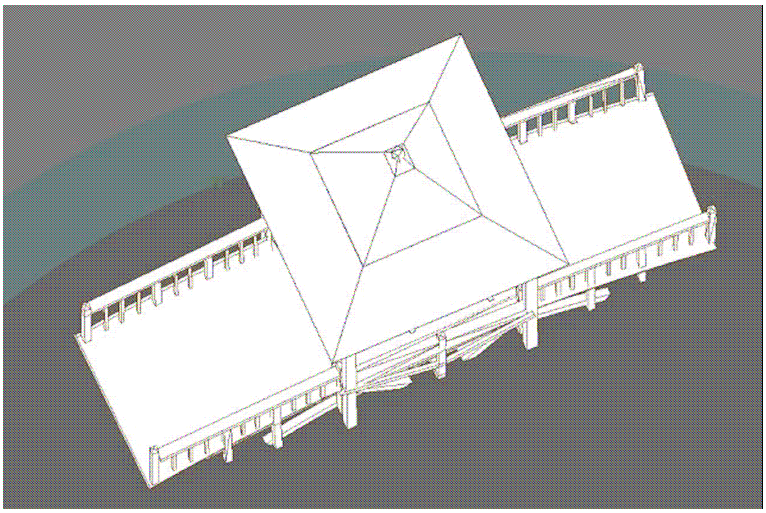

Figure 9: 3D model - top view (display mode: hidden line modeling)

5 Conclusion

The purpose of this study was to make a 3D model of terrestrial scanning for this purpose, a field measurement was carried out taking into account 7 measuring positions located around the object and in its center with a resolution of 2mm for selected scanner distances from the test object. The process of creating the 3D model consisted of a number of tasks: development at Leica Cyclone, scan orientation, recording, measurement noise removal and unification. Orientations taken with an average error of 0.001m. In turn, modeling using solids took place in the MicroStation with the texture attached to the selected one subject of the study. The accuracy of the model largely depends on the density of the point cloud and its resolution, and the point cloud is the basis - a reference to the modeling process. Summing up, along with

the dynamically developing technology, one can observe an increase in the demand for the use of 3D models. A number of programs are being introduced to ensure continued availability increase in their use not only in the circle of surveyors, engineers and architects, but also among people associated with other fields not necessarily technical.

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ZASTOSOWANIE DANYCH NAZIEMNEGO SKANINGU LASEROWEGO W OPRACOWANIU MODELU 3D

W publikacji uwzględniono pomiar obiektu małej architektury techniką naziemnego skaningu laserowego. Ponadto celem nadrzędnym jest wykonanie wizualizacji obiektu w postaci modelu 3D. Model 3D został wykonany na podstawie zunifikowanej chmury punktów z rozdzielczością 2mm w programie MicroStation V8i (SelectSeries 3). Natomiast chmura punktów składała się z 7 skanów, które reprezentowały 7 rozmieszczonych równomiernie w terenie wokół i na środku obiektu architektonicznego stanowisk. Do powiązania skanów posłużyły punkty wiążące- tzw. kule referencyjne charakteryzujące się matową i białą powierzchnią. W programie Leica Cyclone dokonano orientacji skanów i utworzono raport przedstawiający wyrównanie. Na tak utworzonym modelu dokonano unifikacji I wyeksportowano plik za pomocą specjalnych narzędzi aż do momentu otrzymania pliku: „.pod". Na podstawie tego pliku utworzono model 3D. Nie sposób również pominąć procedur takich jak: teksturowanie, wizualizacja, które umożliwiły zaprezentowanie w sposób interesujący modelu wybranego obiektu. Obiektem, który został wybrany był drewniany mostek z ławkami i altaną zlokalizowany w południowo-zachodniej części Parku Dębnickiego przy ul. Praskiej w dzielnicy VIII Dębniki w Krakowie.