

USING OF LASER SCANNING TECHNOLOGY IN A CLOSED AREA

Răzvan Casian REBREAN¹, Denis MIHALI¹

Scientific Coordinators: Prof. PhD. Eng. Mircea ORTELECAN¹, Lecturer PhD. Eng. Tudor SĂLĂGEAN¹

¹University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, Calea Mănăştur 3-5, 400372, Cluj-Napoca, Romania | Tel: +40-264-596.384 | Fax: +40-264-593.792
Email: rebreanrazvan@gmail.com

Corresponding author email: rebreanrazvan@gmail.com

Abstract

This paper aims to present the technology of laser scanner which digitally captures the shape of physical objects using a line of laser light. Three dimensional laser scanner creates point cloud of data from the surface of an object. In another words 3D laser scanning technology is a way to capture a physical object exact size and shape into the computer world as a digital 3 dimensional representation. The first step of this kind of project is the field part. In this case was used a static way of measuring because of the scanner which was fixed during the measurements and was not placed on a moving platform such as airplanes, helicopters. The second step is the modelling part which can be done only by using special software for 3D modelling. This part is the most durable because of the point cloud data. In our software that we have chose to use, this data will be represented in a couple of colors such as: white, blue, red, green and yellow, each color having a meaning. Even though nowadays laser scanning technology is expansive represents a most suitable, better, faster way to take different type of measurements with a large type of data, than using a theodolite, a total station or even GPS technology.

Key words: laser scanning, point cloud, modelling, colors, measurements, surface.

INTRODUCTION

The laser scanner is a fast developing technology, which as grown at an amazing rate since its existence. The most important feature of three dimensional laser scanner is the measurements of fine details and capture free form shapes to quickly generate highly accurate point clouds. 3D laser is ideally suited to the measurements and inspection of contoured surfaces and complex geometries which require massive amount of data for their accurate description.

The data obtained can be used later to realize digital reconstructions, bi-dimensional plans or 3D models, all of these can be harnessed to make different applications.

During the measurements, when the scanner is in a fixed position its being called static laser scanning. The advantages of this method are high accuracy and huge density of points. All static laser scanning can be seen as terrestrial laser scanning. The second method is dynamic laser scanning where the scanner is being fixed on a moving platform. This method requires

positional systems like INS and GPS, which makes it more complex and expansive.

At the beginnings laser scanning had a short range of action being mostly used in cars building industry.

Using a scanner to take measurements of a building does not mean just pushing a button and waiting for the cloud points to show up, it requires a few steps.

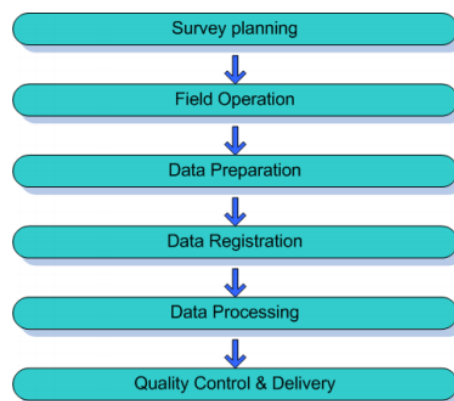


Figure 1. Steps of terrestrial laser scanning

MATERIALS AND METHODS

The first step in this project was to make a plan as in the picture that follows.



Figure 2. Planification of terrestrial laser scanning

We chose our area to survey which is a room placed into a building. The next step was to choose our apparatus, and we have chosen Leica ScanStation C10. This apparatus has an accuracy of a single measurement for position of 6 millimeters, for distance of 4 millimeters and for angles, horizontal and vertical $60 \mu\text{rad}$ / $60 \mu\text{rad}$. The field of view is different in horizontal and vertical view. For horizontal has 360° and for vertical has 270° which is maximum value.



Figure 3. Leica ScanStation C10

Beside the scanstation also were used 4 targets. After the equipment has been chosen the next step was to analyze the room where we can place our targets and the scanstation. For a better visibility and to capture every corner in the room, the scanstation was placed in 4 places, so we had 4 scanning sessions, with targets being in the same position.

An important step is also to decide the resolution. Resolution is defined as the smallest detail of the surface structure that needs to appear in the final project and as highest the resolution will be the processing data will be the same.

During the scanning session the scanned data can be filtered using primary filters. Primary filtration is used to assure that the collected data are placed in accuracy boundaries of scanner register, or to eliminate the points with a low value of reflexion, because those will have a low accuracy.

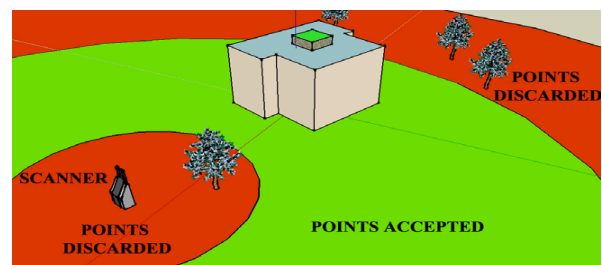


Figure 4. Primary filtration of points

To carry out with the measurements firstly we have to realize the planning of the bases, we have to cover the largest area with the less bases possible and plan the distribution for the targets that we will use to get through the alignment of the targets. This step is of great importance mainly because of the columns that created some blind spots because of that reason we have to be especially careful and establish the targets in a strategical location. When scanning the targets, the scan must have a high resolution, and the software of the scanner can automatically calibrate the shape of the target, and then to find the exact central point of the target. It is very important to check the scan after we finish scanning, because if one scan is missing it will be more expensive, will require more money, checks.

RESULTS AND DISCUSSIONS

This paper is not ready yet, we still have to do some office work. Back in the office we have to check and compare the sketches and notes that we took from the field. It is recommended to begin our work with a copy of the original scan, and to keep the original as a back-up. It is important that the scan file to be seen and easily to be recognized. The software that we used for this it is Cyclone, this software is in charge of geocode and georeference of the cloud points from different positions. From each station there are areas that are not covered by the cloud points due to the possible obstacles, which are the main reason that we have to make 4 stations from different point of views instead of only one in the centre of the room. There are two different ways to do the modelling, one of them is mostly automatic but the other requires more manual work.

With targets is the first way of how to do the modelling, which is more automatic, fastest and easiest. First we create a registration and in that registration we join the scans using the targets. It is an automatic process and we only have to auto-add constraints and in the constraint list register the bases with the targets. When it is done we can see the whole room with all stations joined together creating a point cloud, the colors in the following picture are green, yellow, orange and red. The targets are colored in blue and white. And finally we can take our report.

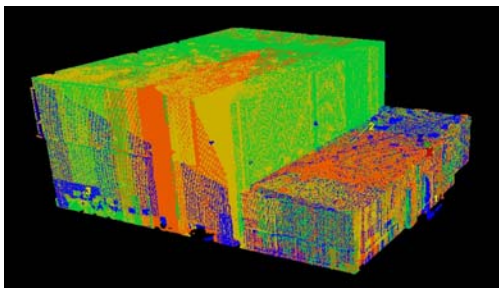


Figure 5. Cloud points

The second way of modelling is without targets. This way is more laborious than the other one, the main difference is that this is not automatic and we can only join two stations at once and this takes longer to complete the model. We create a new registration since this is a new method, in this registration we can

only add two scans in the add-scan world, so we will add the first and second scans. The next step is to find at least 5 pairs of points, we need to find the same point in both scans to make the pair. With the clouds constraint wizard we create two screens where we match the pairs then we press register to save them and finally we create the model with create scan world/freeze. In this model it will only appear the two first stations matched.

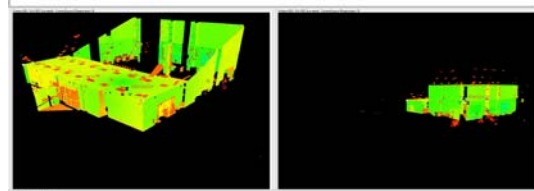


Figure 6. Scan pair

With this last step we can advance and create the report. With the model already done we create another model space “open models pace”. We choose a part of the model with a rectangle tool and with right clicking we open it in a new space model. To finish with the final model we clear out the outside parts of the room with the fence tool, these parts are created mainly because there are filmy materials that let the light pass through.

CONCLUSIONS

Using an scanner it's not only just to press a button and wait for the results, it requires a deep knowledge of the equipment and scanning process, some steps of the scanning process are automatic while others require an intense labor. By using a laser scanner we have lots of advantages like: minimizing our field work and also office work, less opportunities to have a small area not scanned, the possibility to scan different types of angles, and to overright the results, complex results of a high accuracy, instead of measuring just a few points we take a full scan of our object.

REFERENCES

- Learning tools for advanced three-dimensional surveying in risk awareness project, 2008, Theory and practice on Terrestrial Laser Scanning <http://hds.leica-geosystems.com/>
- Sălăgean T., Cartografie Digitală, Universitatea de Științe Agricole și Medicină Veterinară Cluj-Napoca

