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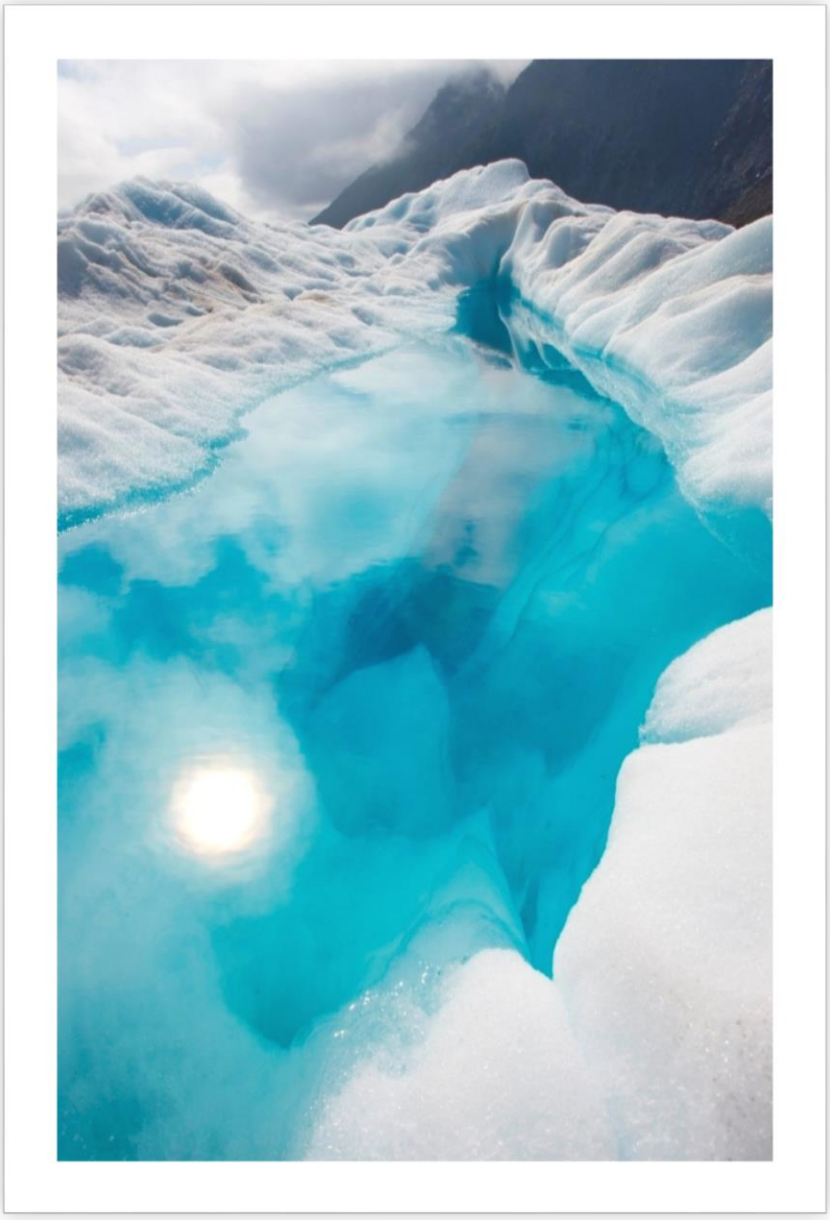
GROUP 1A

12th of December 2016

3. Laser Triangulation – Konica Minolta Vi 910



CONTENT

TABLE OF FIGURES

Objective

The purpose of this lab is to produce a clean 3D model of an object through the software for 3D reconstruction and the Konica Minolta VI-910 laser triangulation scanner.

Introduction

The experiment Laser Triangulation is mainly focused to 3D scan different images by using Konica Minolta Vi 910 laser sensor and to observe the scanned images with respect to the given software's. It employs laser-beam light sectioning technology to scan workpieces using a slit beam. Light reflected from the workpiece is acquired by a CCD camera, and 3D data is then created by triangulation to determine distance information. The laser beam is scanned using a high-precision galvanometric mirror, and 640 × 480 individual points can be measured per scan. We will use two different software's to get the precise point cloud and mesh analysis of the object. This application are more precisely used in industries because of more accuracy. The observed results are labelled with different images.

Equipment

For the proper arrangement of the experiments, we will consider:

- 3D Scanner VI-910 KONICA MINOLTA
- Lenses WIDE / MEDIUM / FINE
- MANFROTTO Tripod
- SCSI to USB Adaptor
- Power Cable and Bag
- 3D WorkStation from DELL
- USB Dongle for Polygon Editing Tool

Software

- Artec Studio from ARTEC Group
- GeoMagic Design X from 3DSYSTEMS

Procedure

Manual 3D Digitization

At First, we select a posture in which the object is seen by the camera in most its body and we place it on the rotating platform. Once this is done, we can proceed to open the software *Polygon Editing Tool* and to start scanning. As it is seen in below figure, just when the scanning is started, the software displays the interaction window through which you can tune the acquisition parameters and four display windows for the 3D object. All the non-registered data is displayed in the Observation Windows.

The color of the image can't reflect the same image but it features the look of the model VI-910. The device has in-built 4 layers of filters, being:

- An infrared filter
- Red optical filter

- Green optical filter
- Blue optical filter

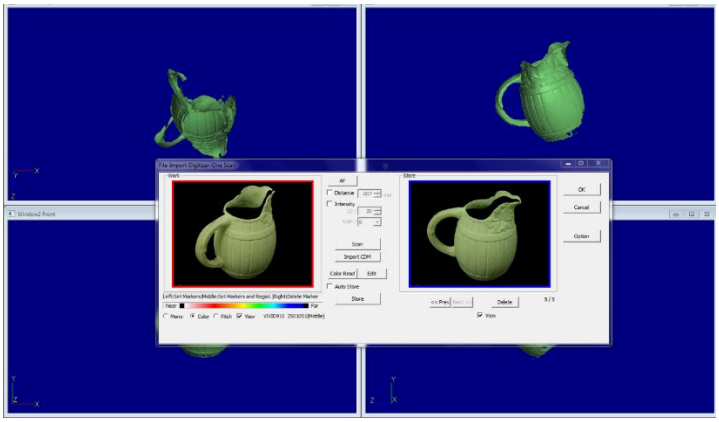


Figure 1. Scanning window

So when the X, Y, Z coordinates are acquired, the same happens with the RGB components of the color of the object.

If we don't specify anything, the registration of the points is done automatically by the software, what leads to bad connections between the different scans.

The solution to that is, during the acquisition, between scan and scan, to select at least 3 pairs of corresponding points in "Work" and "Store" windows. Registering is performed as soon as the number of corresponding points is sufficient and it updates the 3D model and proceeds to the next scan.

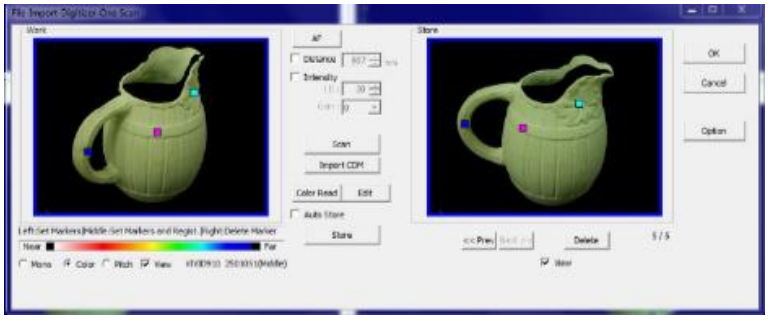


Figure 2. Selecting the points

Once the views have been stored, we can check them in the same windows to agree in their correctness. If the acquisition is satisfactory, we can record this object in CDM file format (as it allows to add views later). After that we export it into VVD format.

Post-processing

We start now the new tool of the lab: Geomatic Design X, which will be used to do the post-processing of the data previously acquired. In this part, three main corrections are followed for data: smoothing, filling holes and optimizing size of the mesh.

Once we have imported the data (selecting all the '. vvd' files at the same time), we can apply different post-processing tools to it:

- Align the different scans
- Merge them
- Clean the mesh
- Remove extra Shell points
- Fill remaining holes

Figure 3. Post processing of the object

All the steps commented above can be re-applied in case the mesh is not accurate enough. The results achieved are labelled in the above figure.

Automatic 3D Digitization

Now we have achieved the goal of creating a 3D-mesh out of manual scans, we proceed to automate the process (we can do it because VI-910 can make multiple shots of an object by controlling the rotary stage remotely from the Polygon Editing Tool software.

To calibrate the system, a calibration chart on the platform is used to extract the center of rotation as mentioned in figure 4.

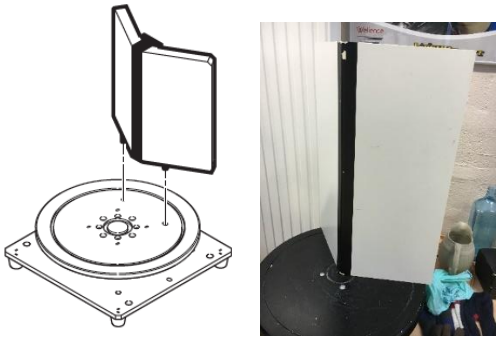


Figure 4. Calibrating the setup

In order to perform auto-scan, we must check the specific cell in the acquisition window, so the process can be done autonomously by the camera.

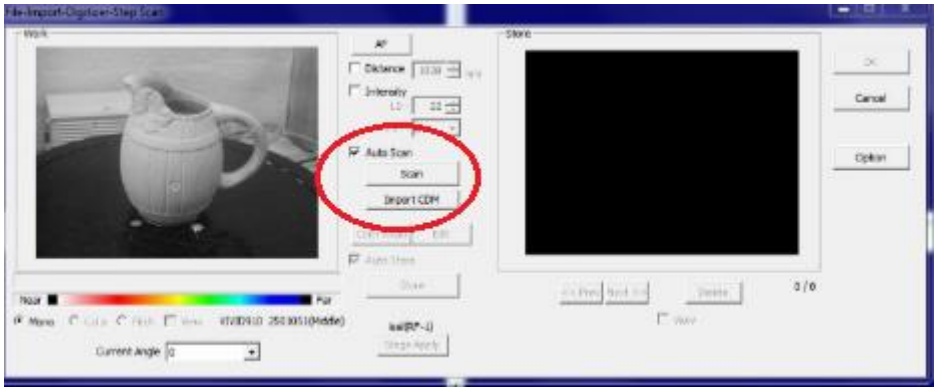


Figure 5. Scanning window for automatic scan

The intensity of the laser beam can be also modified, but that can lead to having more **noise** in the acquisition and it will be a drawback for registration.

It is important to assure the object will not go out of the field of view of the scanning device, because it would be very damaging for the registration to move the object once the scanning is in progress.

What is observable being the laser is it does three passes over the target object, as this increases the robustness of the scan (the laser beam can be seen in figure 6, where we have increased the intensity on purpose to be able to see the laser itself).

Figure 6. Laser beam

Conclusion

We have conducted an experiment in which we applied the high-cost 3D sensor Konica Minolta VI-910 to obtain a reconstruction of an object. The results are clear:

- We see drawbacks to using Konica Minolta:
  - As well as other 'high precision' devices, the prices are enormously high compared to a 3D camera like the Microsoft Kinect.
  - It is difficult to scan non-visible parts of objects (like the bottom of them).
  - They are devices difficult to carry.
- The advantage is simple:
  - They have a very good accuracy (about 0.1mm of error).