3D RECONSTRUCTION PROJECT

TOF APPLICATION TUTORIAL

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Introduction

This application is a way to use the TinTin ToF camera from Texas Instrument. It allows you to get data from it, filter the 3D point clouds, visualize them, and save the results in files. The main goal of this software is to combine the camera with a turntable and therefore make a 3D scan of an object.

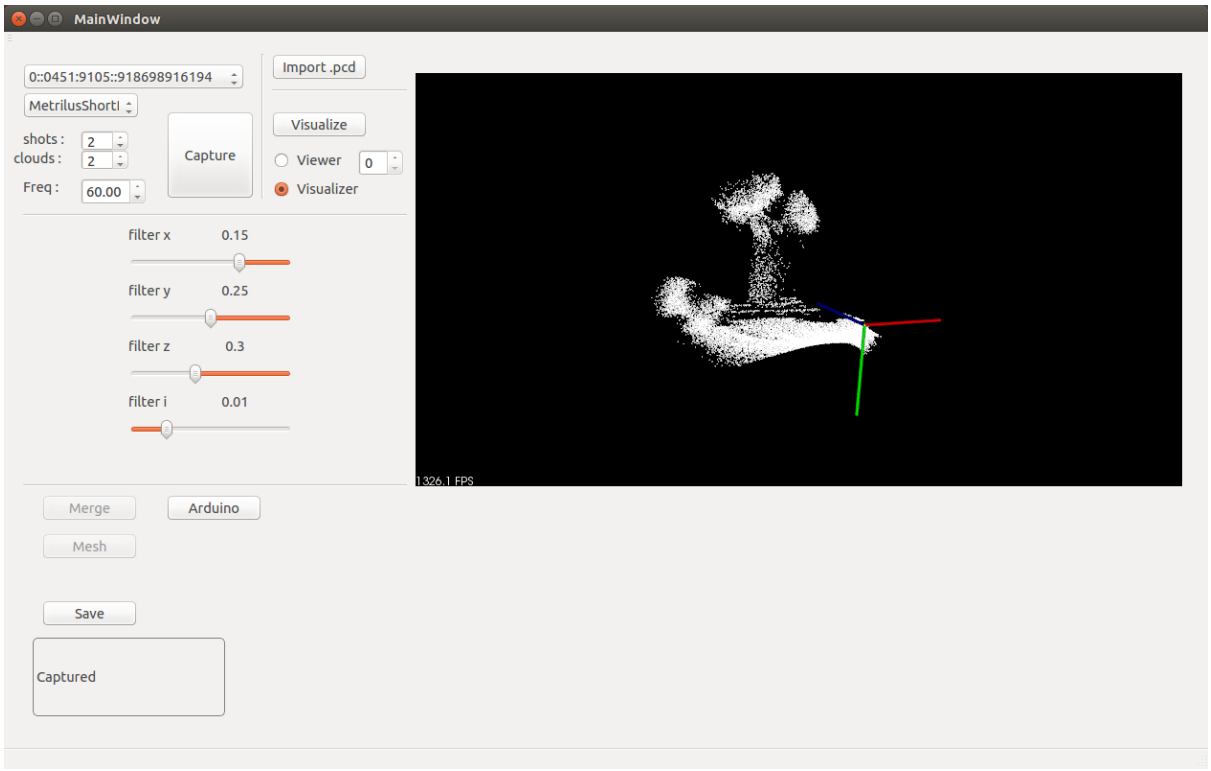

Figure 1: Overview of the application

Getting Data

From the camera

Getting data form the camera is the main goal of the application. You can directly capture data with the top left corner of the gui.

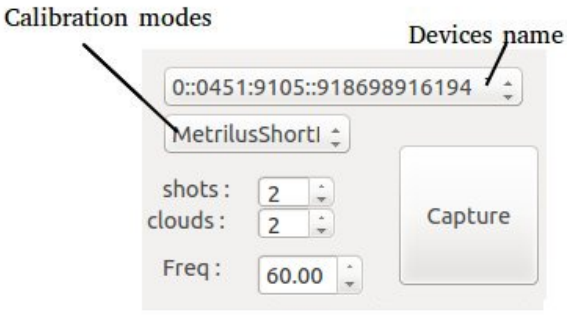

Figure 2: Capture data from the camera

The application will detect all the plugged cameras from the running time. If no camera is plugged when you open the application, or if you plug it later on, the combo boxes will appear blank and you will have to restart the program.

If one or more cameras are detected, you can visualize their names and tunable parameters in the gui. First select the name of the camera you wanna configure and its calibration mode. The obtained results can be really different according to the calibration mode. For our tests, we have observed that the most appropriate calibration mode was the "Metrilus Short Range", because it captures properly a nearby object without deformations. Planes can appear curved with other calibration modes.

The tunable parameters are the number of shots in a cloud, the number of clouds to capture at once and the frequency of the shots.
The shots are the number of times the camera sends rays and observes them. When you increase the number of shots, the captured data are more accurate but the building of a point cloud takes more time. We advise you to set this parameter between 2 and 4.
The number of clouds is the number of point clouds that will be taken one after the other, delayed by around 1 or 2 seconds.
The frequency is the one which the camera will consider for sending infrared shots. We have disable this parameter in our last release because it was a bit useless at the end, and made the program crash when the frequency was too low. You can retrieve this function by uncommenting some part of the code.

Once you have fixed everything, you can click on "Capture" and wait for seeing "Captured" in the info box.

From files

When you have already got your 3D data from a previous session and you want to process then now, you can import them from .pcd files.

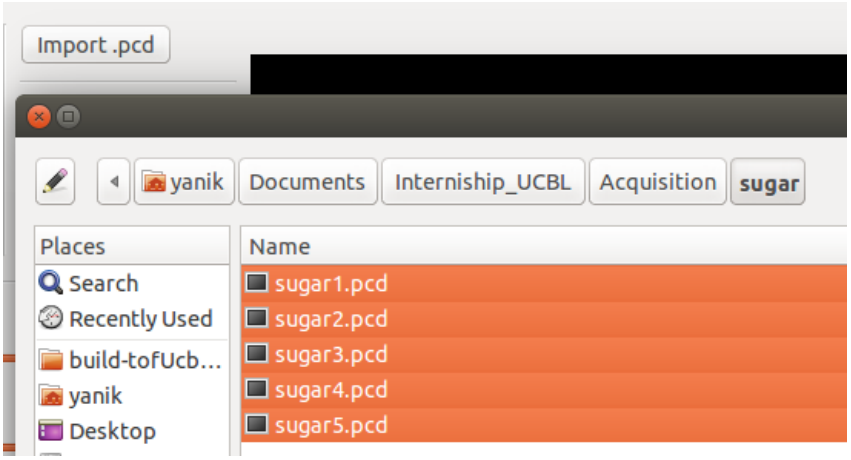

Figure 3: Import point clouds from files

Click on the "import .pcd" button and select one or multiple .pcd files. Each .pcd file contain a point cloud with x, y, z and intensity value.

VISUALIZE DATA

After capturing or importing data, your main interest is to visualize them.

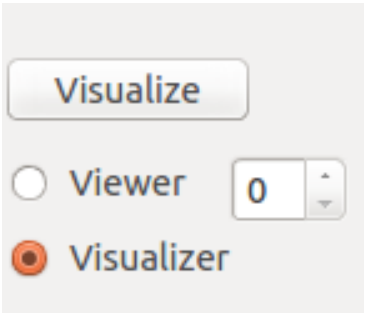

Figure 4: Visualization options

TAs you know, the data contain an intensity value. The PCL library allows you to visualize the point cloud with this information or not. That is why two different frame or proposed in order to visualize the data.

One frame is the visualizer and does not contain intensity information in the display. This one is embedded in the gui and is simpler in use.

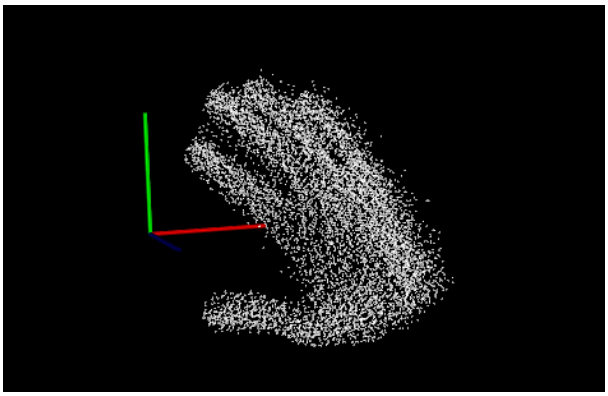

Figure 5: Visualizer frame

The other frame is the Viewer and display the points with colors according to their intensity value. This one will appear in a pop up window. Use it only if you need this information.

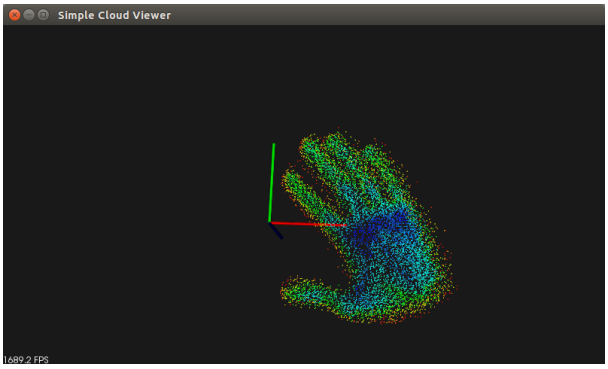

Figure 6: Viewer frame

FILTERING THE DATA

Filtering is an important step if you want a proper rendering of the point cloud. You can discard useless points by filtering in the x, y, z axis and according to the intensity of the points.

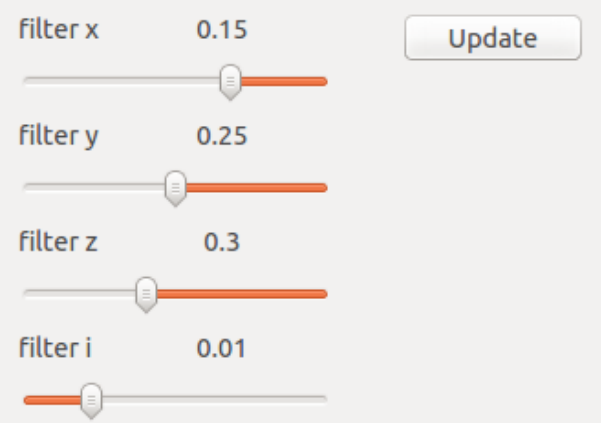

Figure 7: Filtering options

Indicated values for x, y and z are in meters. For the x and y axis, it keeps only the centimeters written on left, right, above and below the origin. For the z axis, it keeps the centimeters after the origin. If you wanna filter in intensity, move the slider "filter i" and this will discard all the points that have an intensity lower than the one you have fixed.

While capturing, it automatically filter the point cloud with the indicated values. So it is better to tune them with large values before getting the data. You can filter them a bit more later on by using the update button.

All these parameters have been fix for a usage of the camera with a turntable. If you do not change the values that are fixed from the running time of the program, you will have a proper rendering of the object located on the turntable.

Filtering is performed on all the opened point clouds, when you capture and also when you update the values.

USING THE TURNTABLE

Actually, the application has been build in order to make a full 3D scan of an object thanks to a turntable. An arduino board connected to a motor and the computer allows to make small rotations of the object and take multiple clouds from the object faces.

If an Arduino board is plugged into the computer, click on the Arduino button and the description of the board will appear in the info box. This makes also the connection between

the Arduino and the computer. Then you can run a capture of multiple clouds and the motor linked to the arduino will rotate the turntable with few angles between each cloud.

PROCESSING THE DATA

Once you have got all your data from different captures of the object faces or imported from before, you can merge all the clouds into one single and dense pointcloud which will form a 3D scan.

If multiple clouds are opened, you can click on the Merge button and this will run the merging algorithm. This algorithm is based on ICP (iterative point cloud) and try to find the best transformation between one face and an other. It keeps track of all the transformation and compute a global one which is related to a reference cloud.

Figure 8: Pairwise Incremental Registration

While processing ICP algorithm, a window will pop up showing how the points are moved between the clouds in order to find the best matches between two faces. Once it is finished, the main gui will be accessible and you can visualize the dense result.

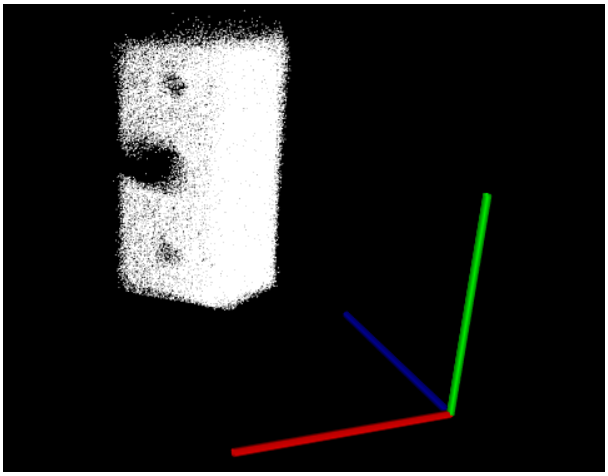

Figure 9: Pairwise Incremental Registration

SAVING YOUR RESULTS

If you want to keep your processed point clouds, you can use the save button. This will ask you to choose a folder and a name for you files. This will save all the point clouds under that name, a number and the .pcd extension (for example : cloud0.pcd, cloud1.pcd, ...) .