MANUAL v0.25

4 November 2023

Contents

Chapter 1

Introduction

This manual v0.25 is prepared for mobile mapping system `https://github.com/JanuszBedkowski/mandeye_controller/blob/main/doc/manual/manual_v0_1/mandeye_dev_manual_v0_1.pdf`MANDEYE available as open hardware project. The software is composed of:

- Lidar odometry (for initial trajectory calculation),
- Multi view terrestrial laser scan registration (for final trajectory calculation).

To use the software click the link below:
`https://github.com/MapsHD/HDMapping/releases`
and download the latest version of files: laszip3.dll, `lidar_odometry_step_1.exe`, `multi_session_registration_step_3.exe` and `multi_view_tls_registration_step_2.exe`. Then put all of the downloaded files in one folder and proceed to next chapter.

Chapter 2

Lidar odometry

This software calculates trajectory based on Lidar and IMU data. It based on novel approach that I did not have opportunity to publish (work in progress). Basically it is SAM (Smoothing and Mapping) approach that is using multi view Normal Distributions Transform in pose graph SLAM framework writen from scratch in Python (SymPy) and C++ (Eigen).

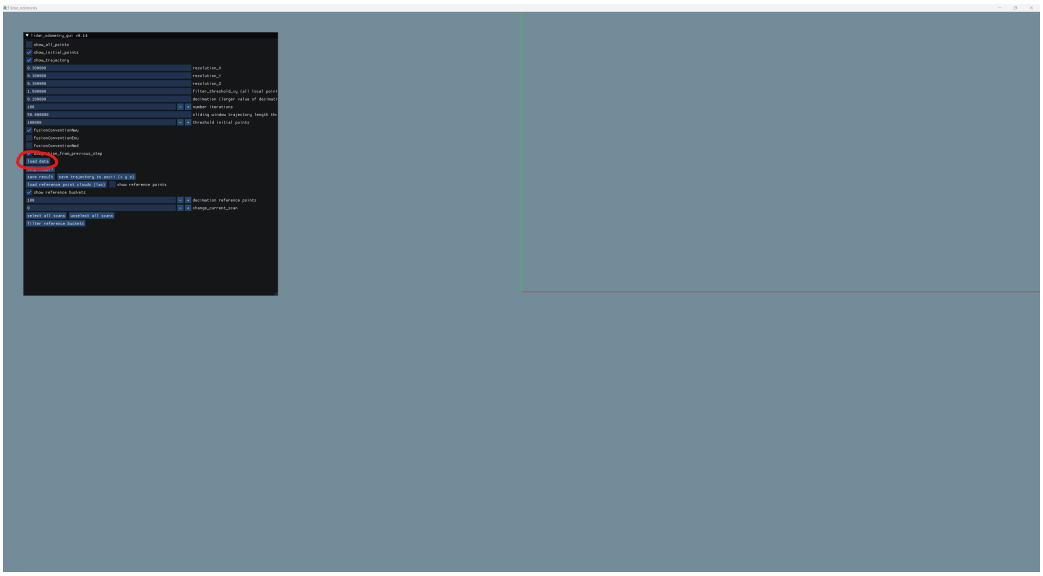

Figure 2.1: Step 1 - loading data.

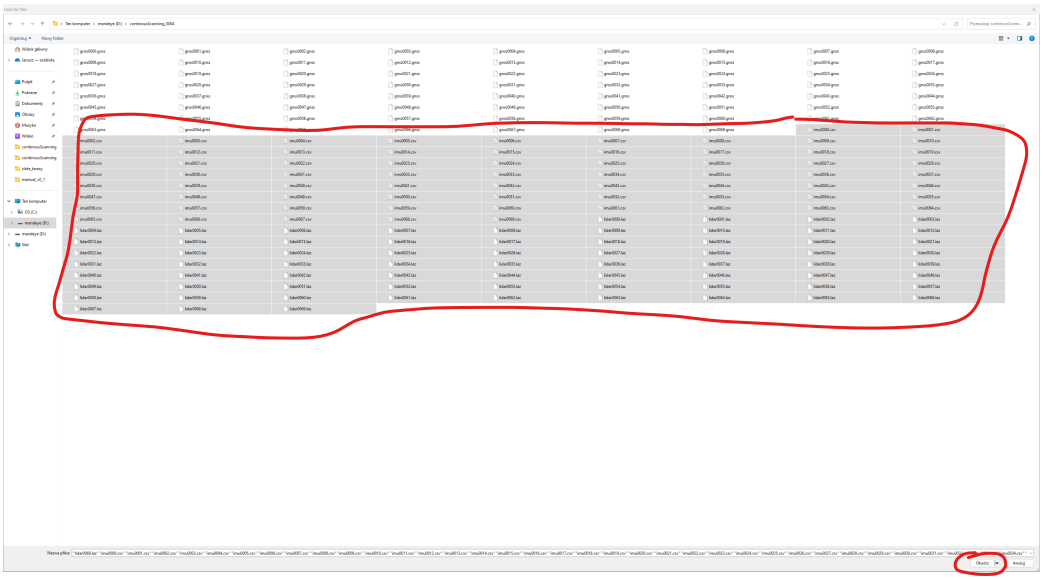

Figure 2.2: Step 2 - select all *.csv and *.laz files from folder that MANDEYE mobile mapping system created on USB drive.

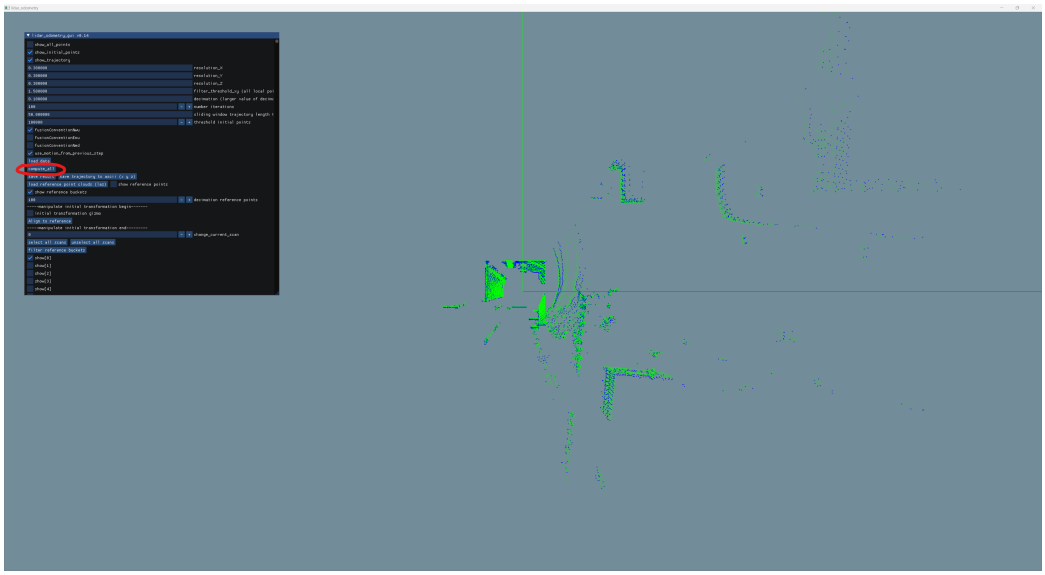

Figure 2.3: Step 3 - press 'compute all'. Check console mean time and folder 'preview'.

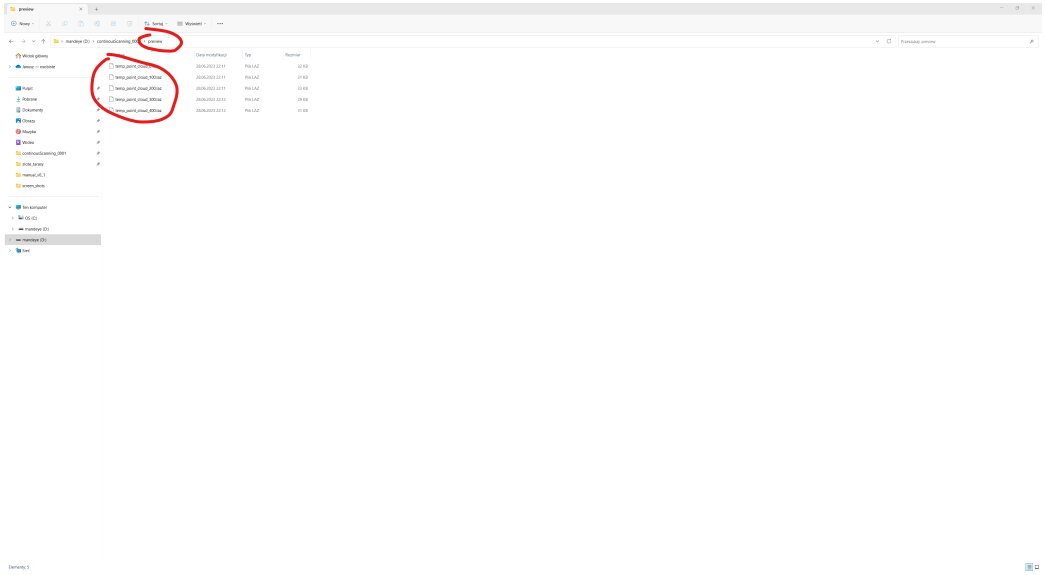

Figure 2.4: Optional step: intermediate results are stored in 'preview' folder.

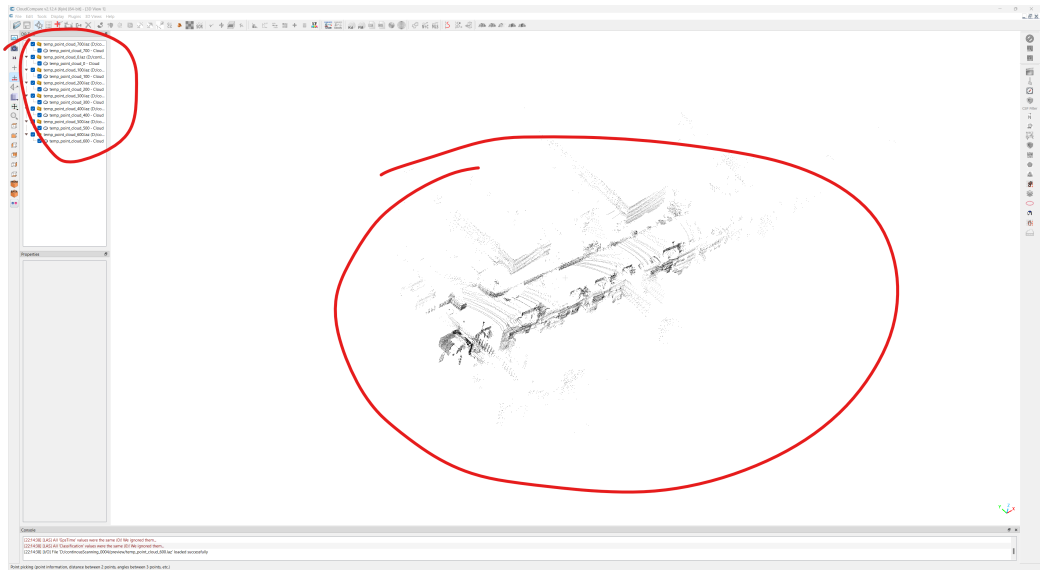

Figure 2.5: Optional step: You can watch the progress in open source CloudCompare software by loading all *.laz files from 'preview' folder.

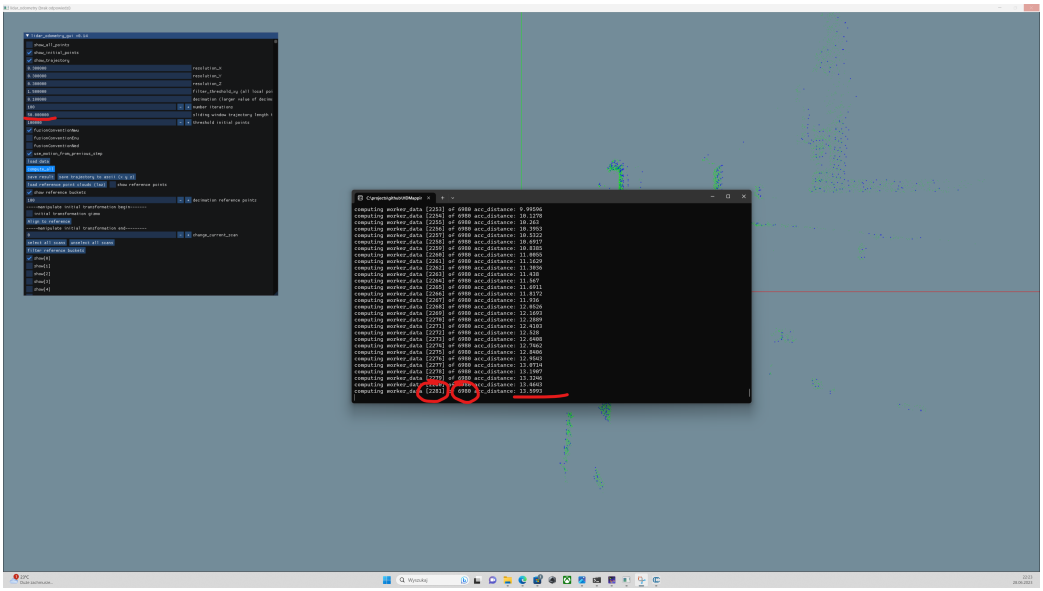

Figure 2.6: Progress in console.

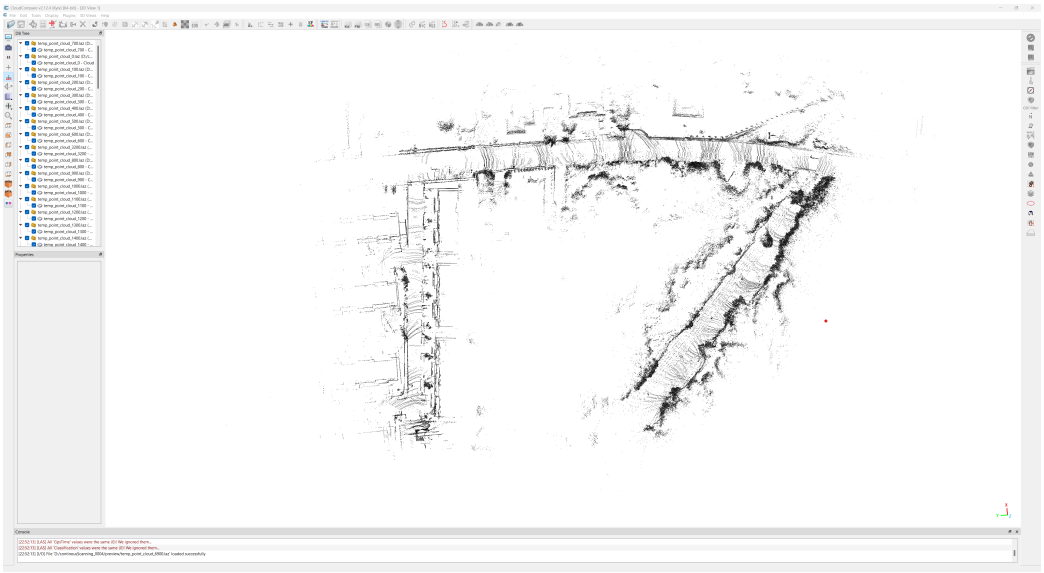

Figure 2.7: Final data in CloudCompare.

Figure 2.8: Final data ready for export.

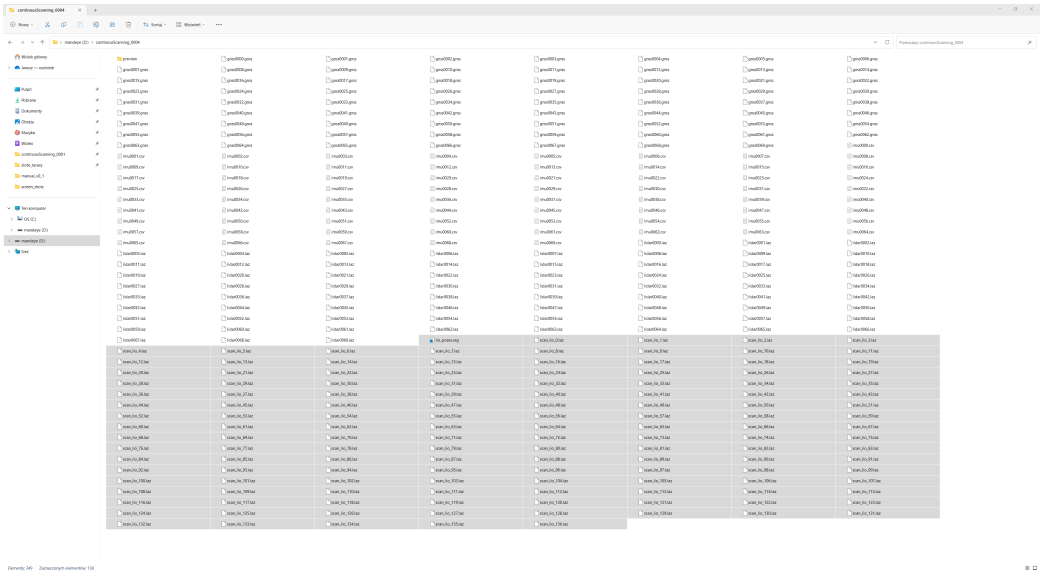

Figure 2.9: Exported final files.

Chapter 3

Multi view terrestrial laser scan registration

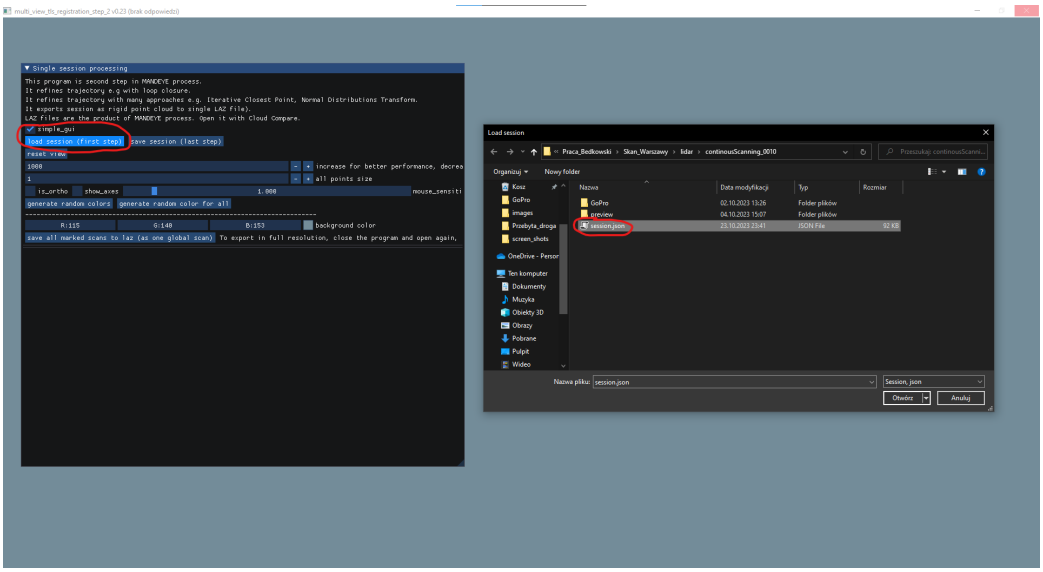

Figure 3.1: Load session.json prepared by 'Lidar odometry'.

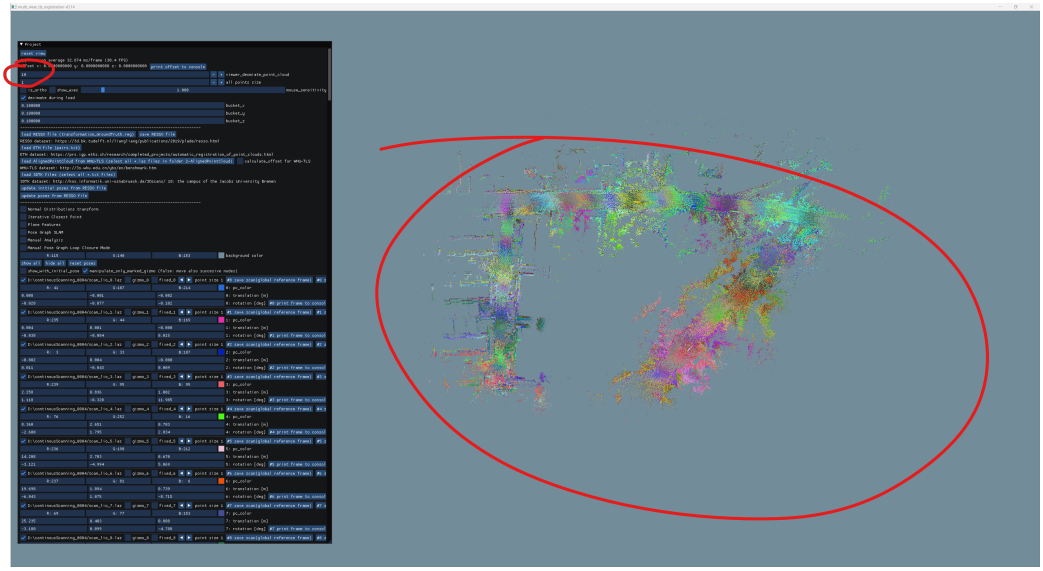

Figure 3.2: Prepare field of view and change decimation to see more points. Generate random colors option is recommended for next steps as every scan will be in a different color.

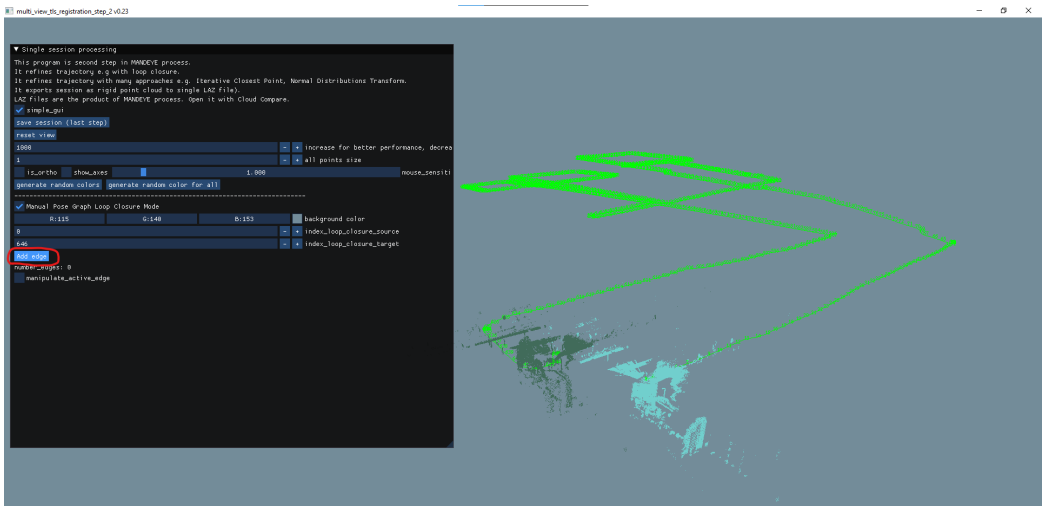

Figure 3.3: Turn on Manual Pose Graph Loop Closure Mod, then choose two different scans that share scanned objects, but difference in their numbers is as big as possible e.g. when you made a loop during scanning and came back to the same place after some time. Then click add edge.

Figure 3.4: Turn on manipulate active edge, turn on gizmo and align scan to scan manually.

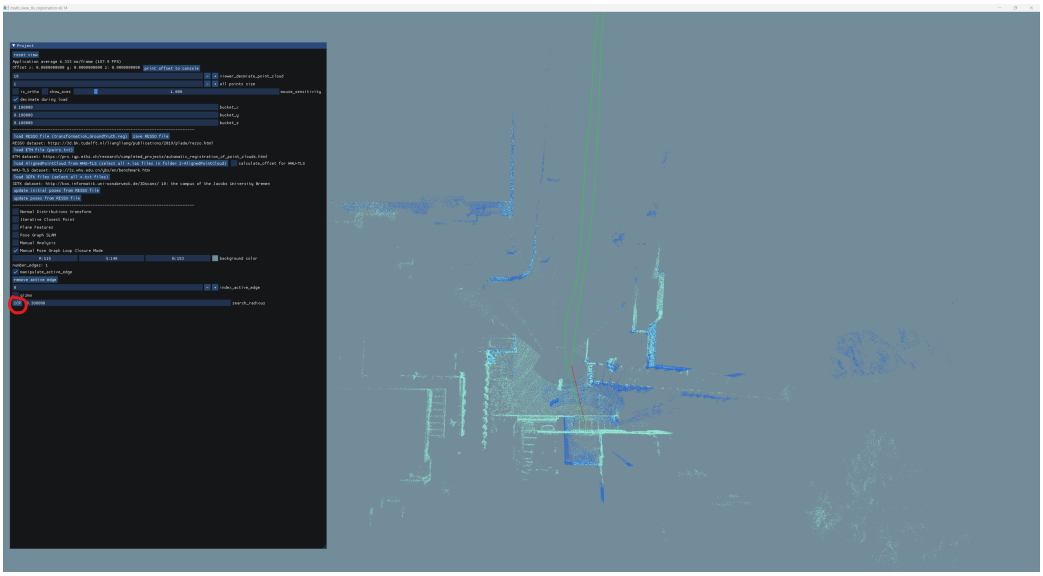

Figure 3.5: Once You are not capable align more accurate, then turn off gizmo and repetitively use ICP until scans align to the level at which nothing can change anymore.

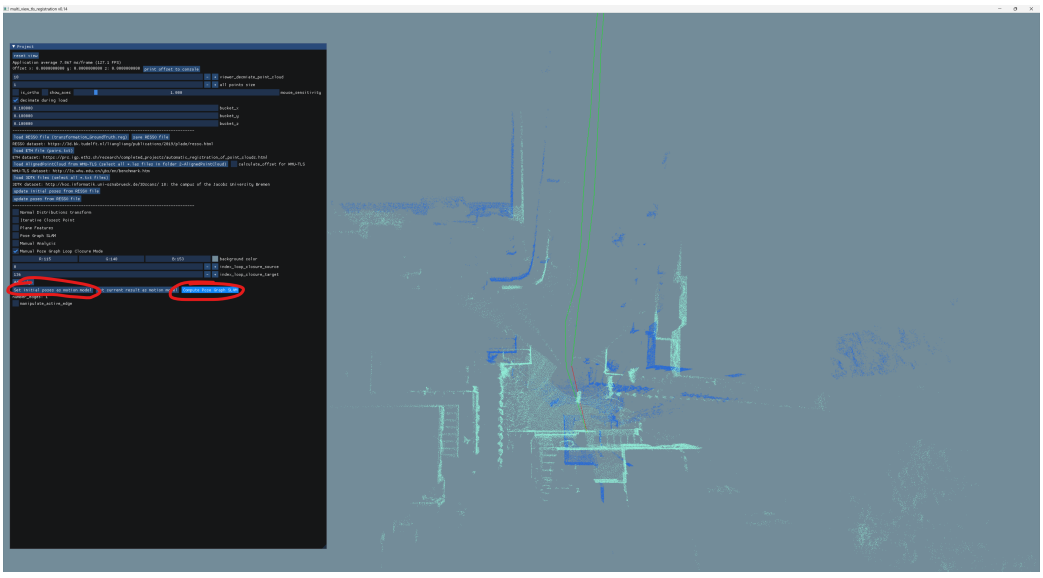

Figure 3.6: Turn off manipulate active edge, click "set initial poses as motion model", then click "compute pose graph SLAM".

Figure 3.7: Turn off Manual Pose Graph Loop Closure Mod and inspect if everything is ok, if not, repeat steps from figures 3.3-3.6 (choose another pair of scans, refine them and compute the pose graph SLAM).

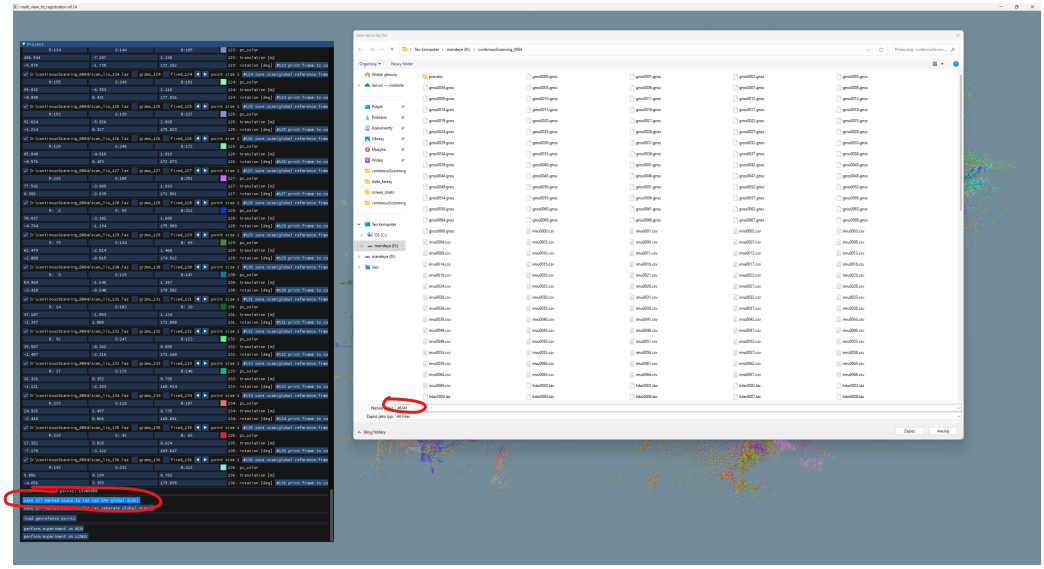

Figure 3.8: Once the job is done export data to *.laz. This is Your map that can be loaded by e.g. CloudCompare.

Chapter 4

Questions from end users

Do you have recommendations on how to best record data?
I recommend stop/scan mode for most accurate mapping. Continuous mapping is for increase the time of the survey.
How much distance can be between two consecutive start/stop acquisitions?
I suggest not more than 10 meters.
Do they need to overlap? To which degree?
Stop/scans should be overlapped at least 50%.
Continuous scanning: can the sensor change its tilt/angle during the recording phase? Or does it assume being in a upright position all the time?
I suggest that MANDEYE is somehow a upright position all the time.
How "fast" am I allowed to move (I actually did a rather slow walk).
I was tested it up to 10 km/h
Can the sensor change height while recording?
Yes.