MANUAL v0.25

November 20, 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 (step 1)

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).

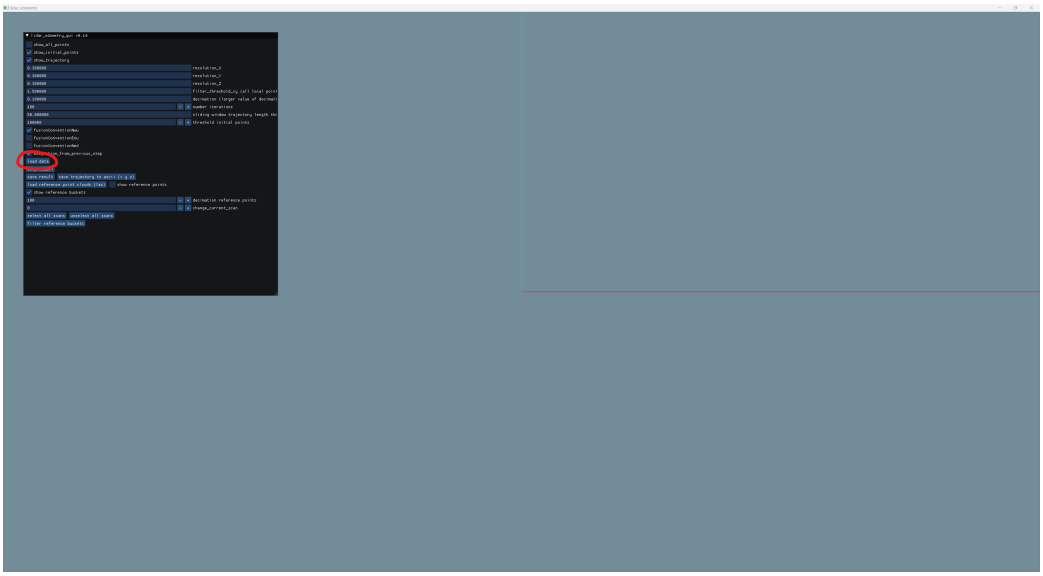

Figure 2.1: Step 1 - loading data.

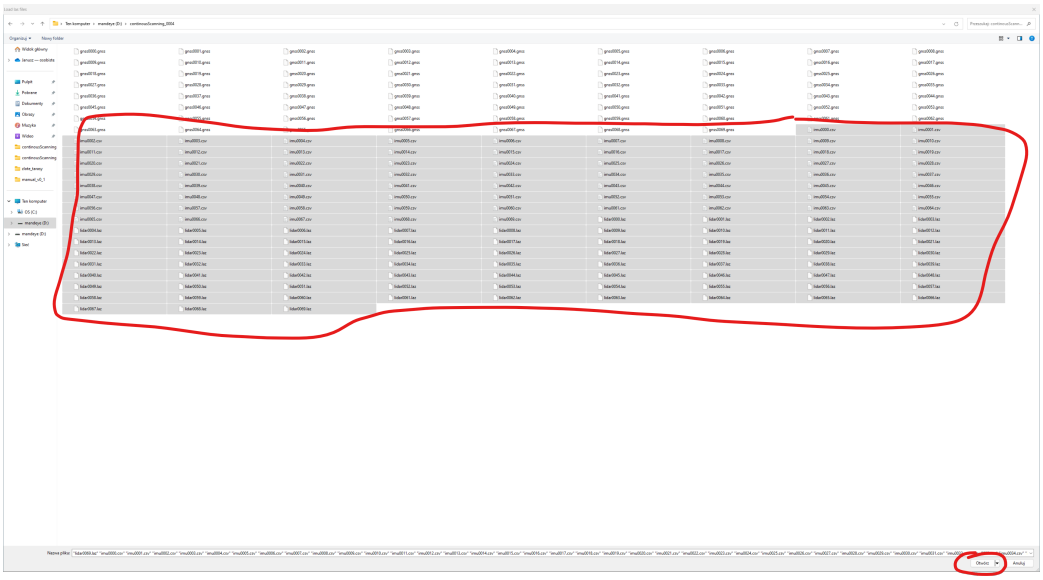

Figure 2.2: Step 2 - select all *.csv and *.laz files from folder that MANDEYE mobile mapping system created on USB drive.

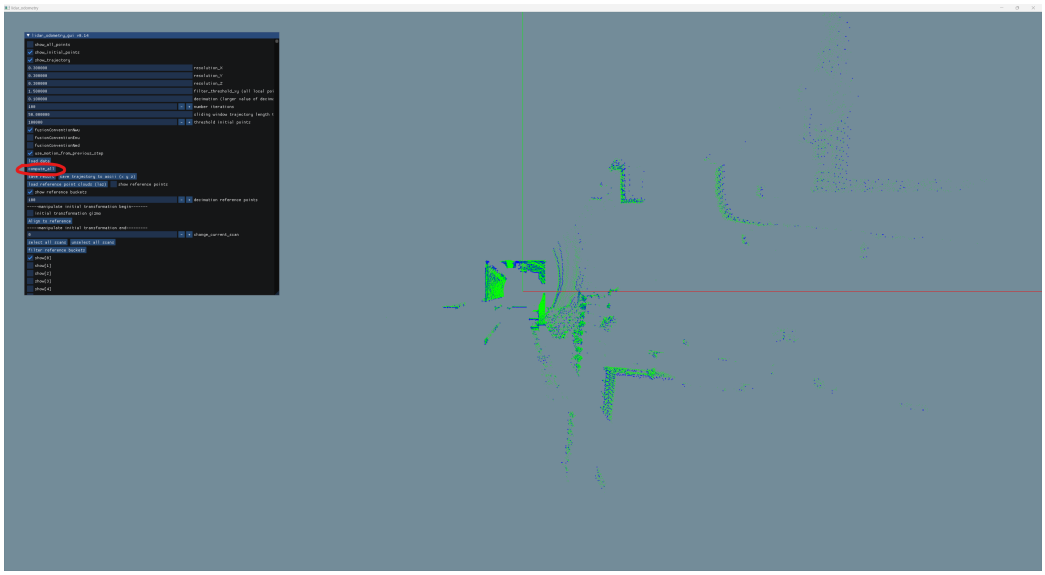

Figure 2.3: Step 3 - press 'compute all'. Check console mean time and folder 'preview'.

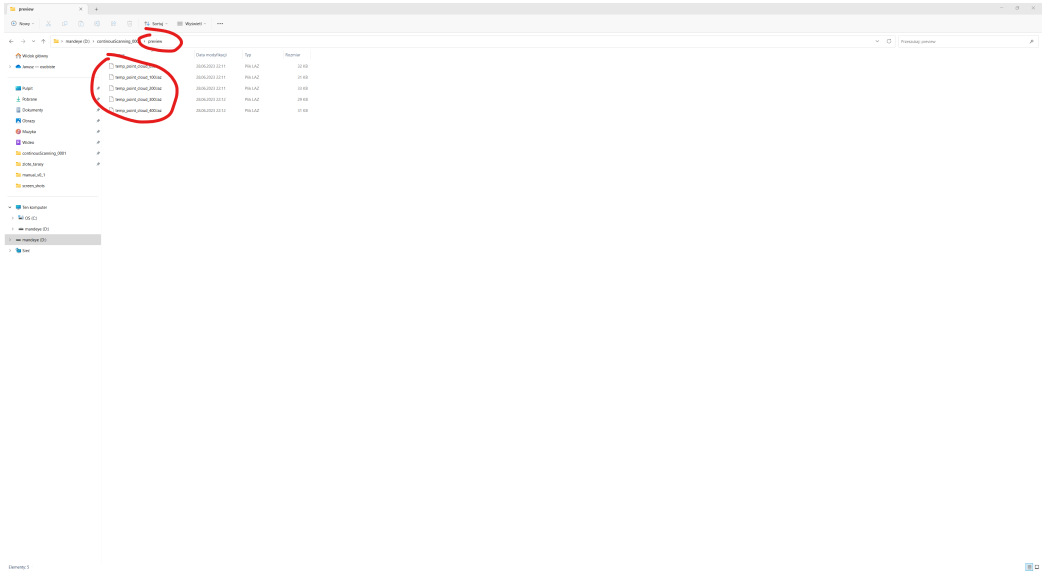

Figure 2.4: Optional step: intermediate results are stored in 'preview' folder.

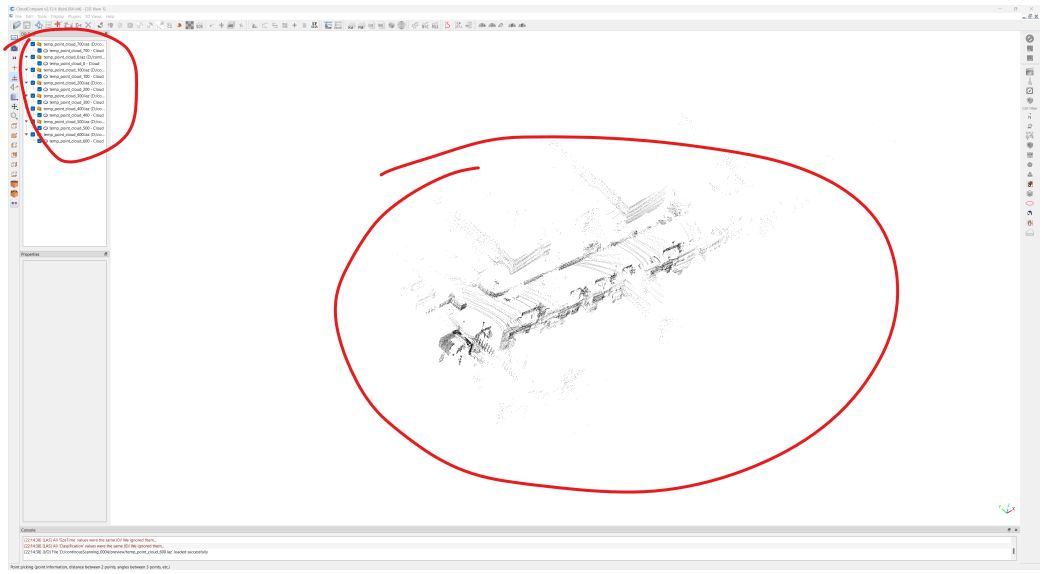

Figure 2.5: Optional step: You can watch the progress in open source CloudCompare software by loading all *.laz files from 'preview' folder.

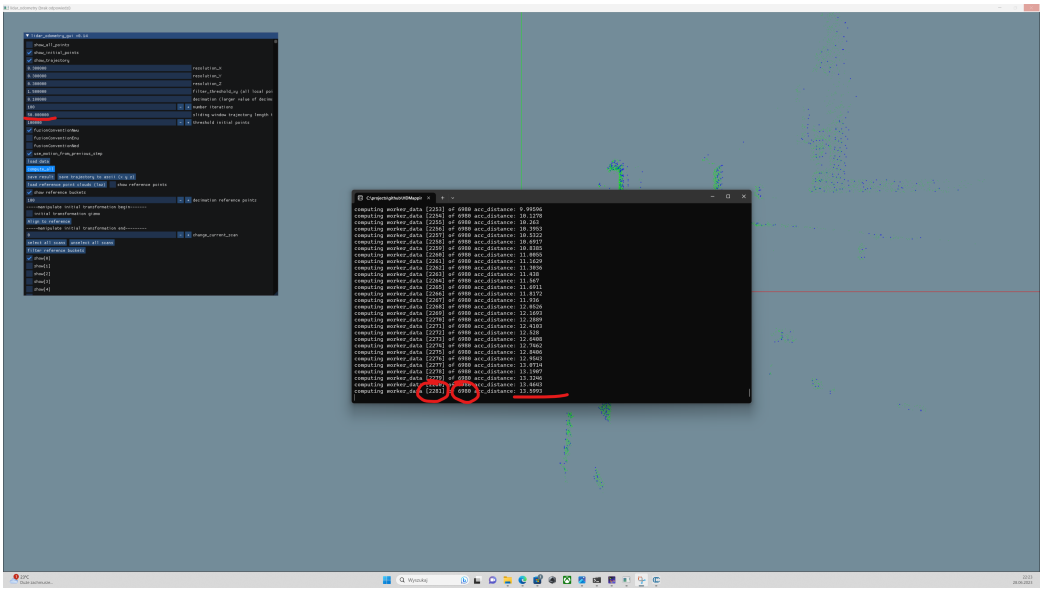

Figure 2.6: Progress in console.

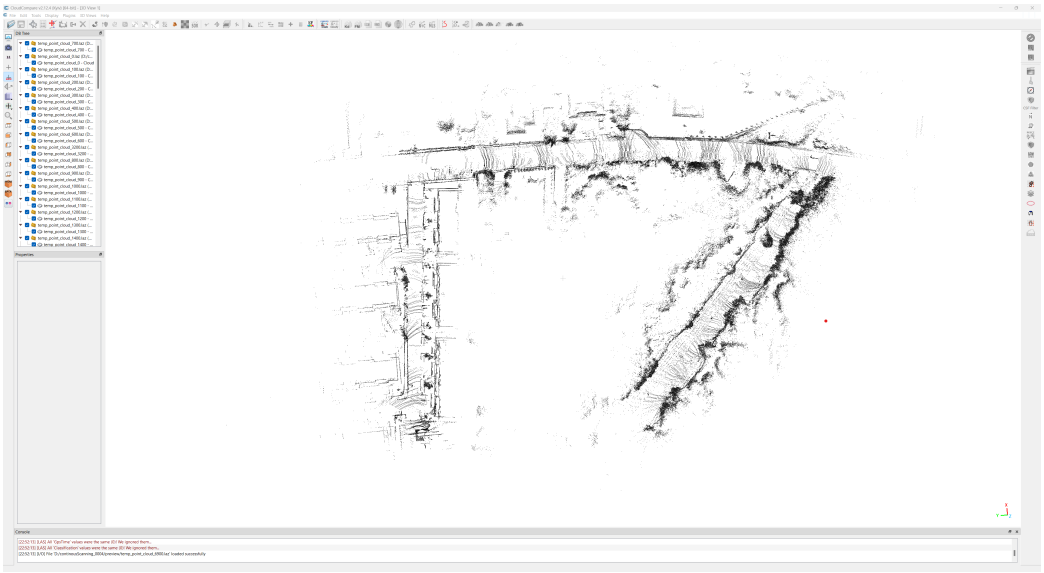

Figure 2.7: Final data in CloudCompare.

Figure 2.8: Final data ready for export.

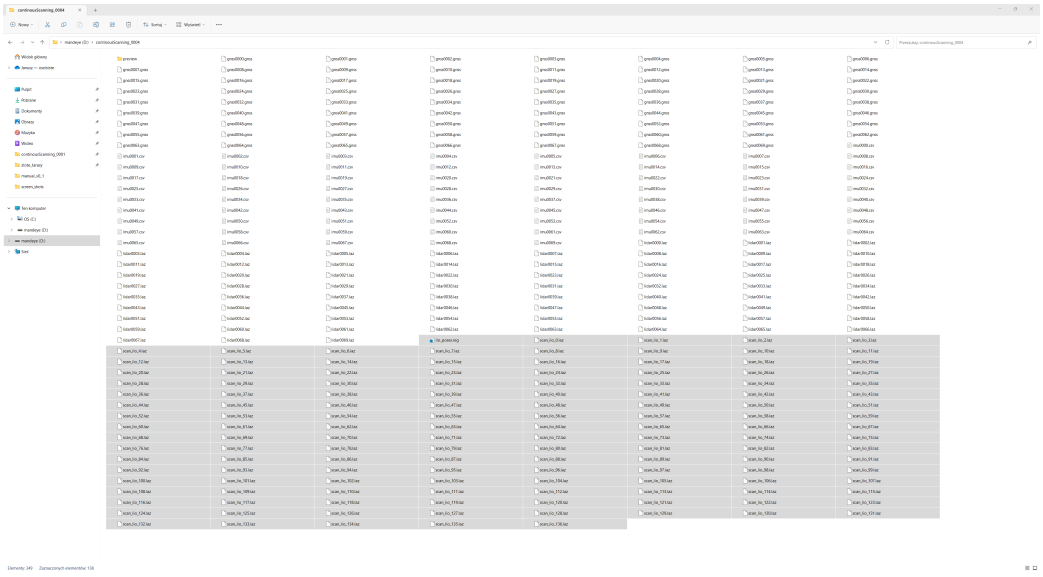

Figure 2.9: Exported final files.

Chapter 3

Multi view terrestrial laser scan registration (steps 2 and 3)

3.1 Step 2

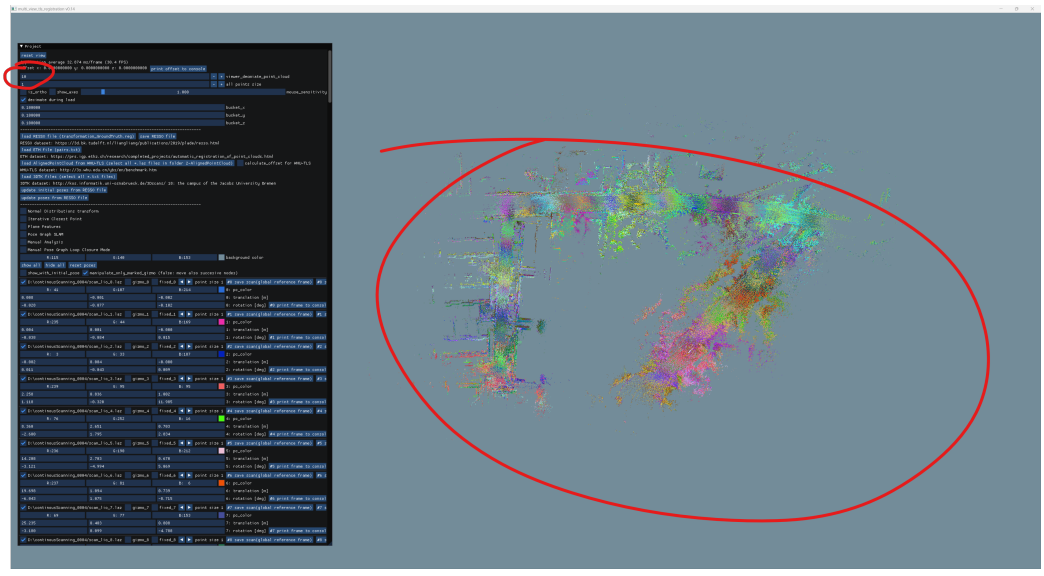

Figure 3.2: Prepare field of view and change decimation to see more points. Generate random colors option is recommended for next steps as every scan will be in a different color.

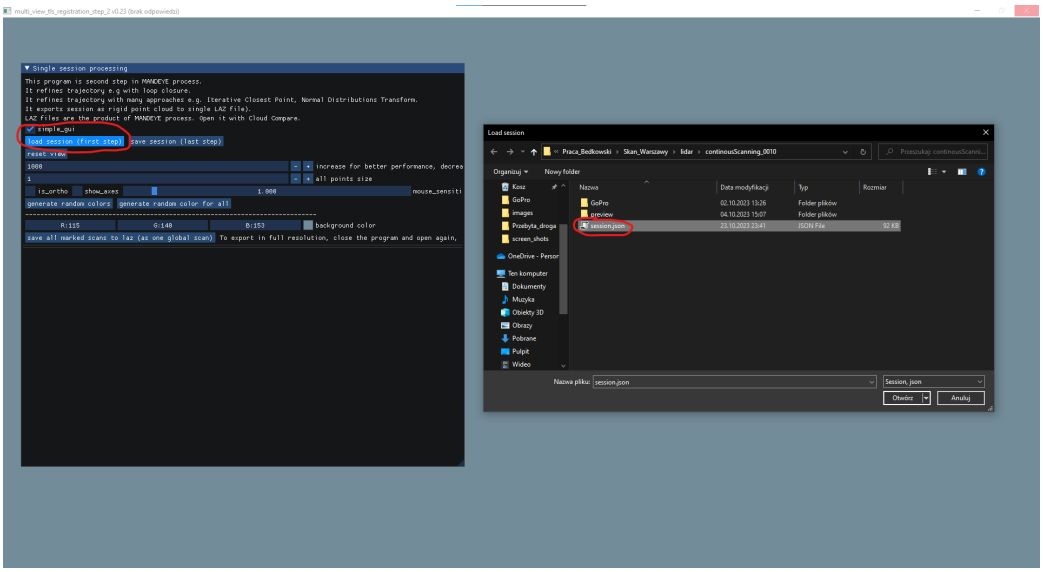

Figure 3.1: Load session.json prepared by 'Lidar odometry'.

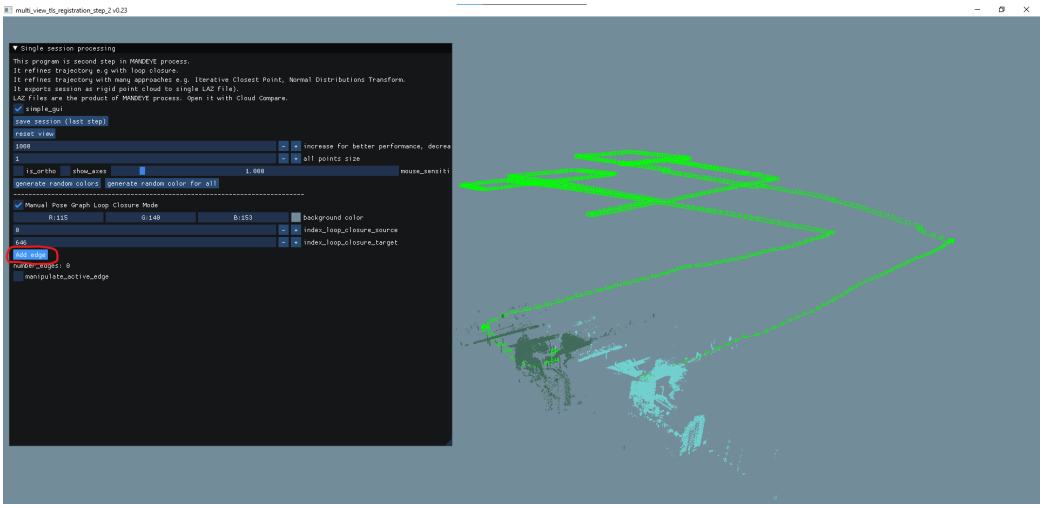

Figure 3.3: Turn on Manual Pose Graph Loop Closure Mod, then choose two different scans that share scanned objects, but difference in their numbers is as big as possible e.g. when you made a loop during scanning and came back to the same place after some time. Then click add edge.

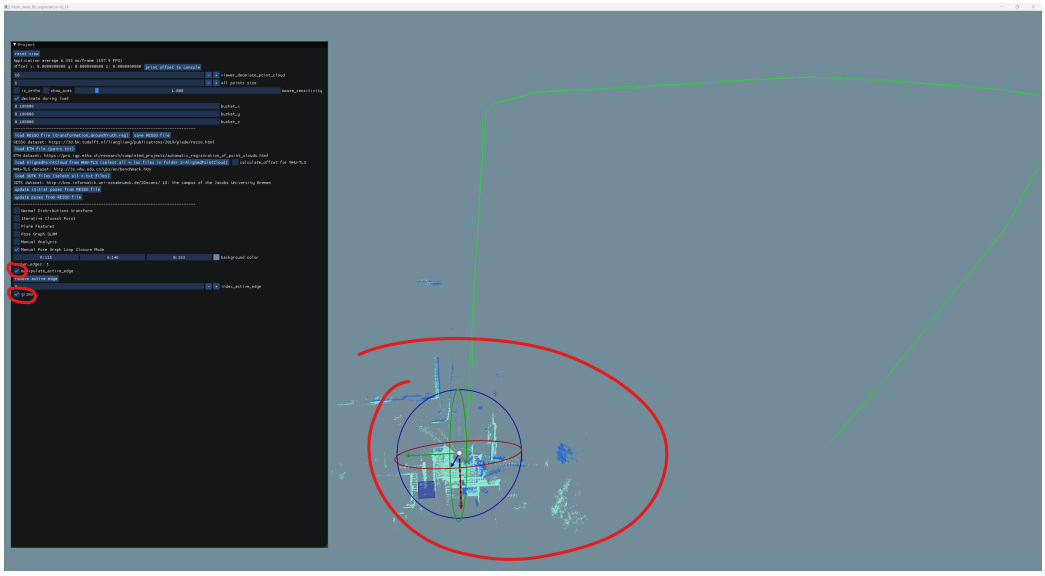

Figure 3.4: Turn on manipulate active edge, turn on gizmo and align scan to scan manually.

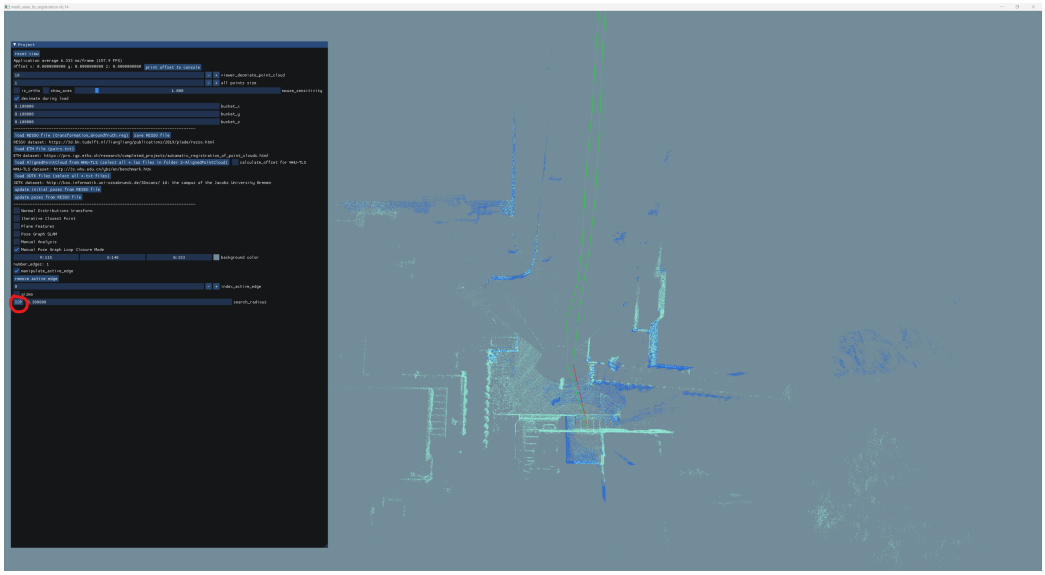

Figure 3.5: Once You are not capable align more accurate, then turn off gizmo and repetitively use ICP until scans align to the level at which nothing can change anymore.

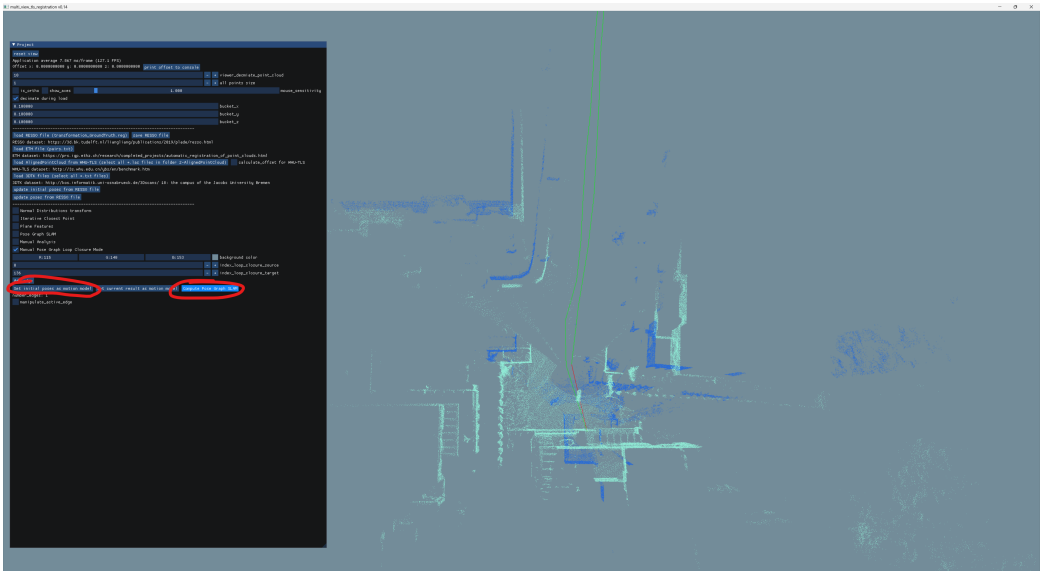

Figure 3.6: Turn off manipulate active edge, click "set initial poses as motion model", then click "compute pose graph SLAM".

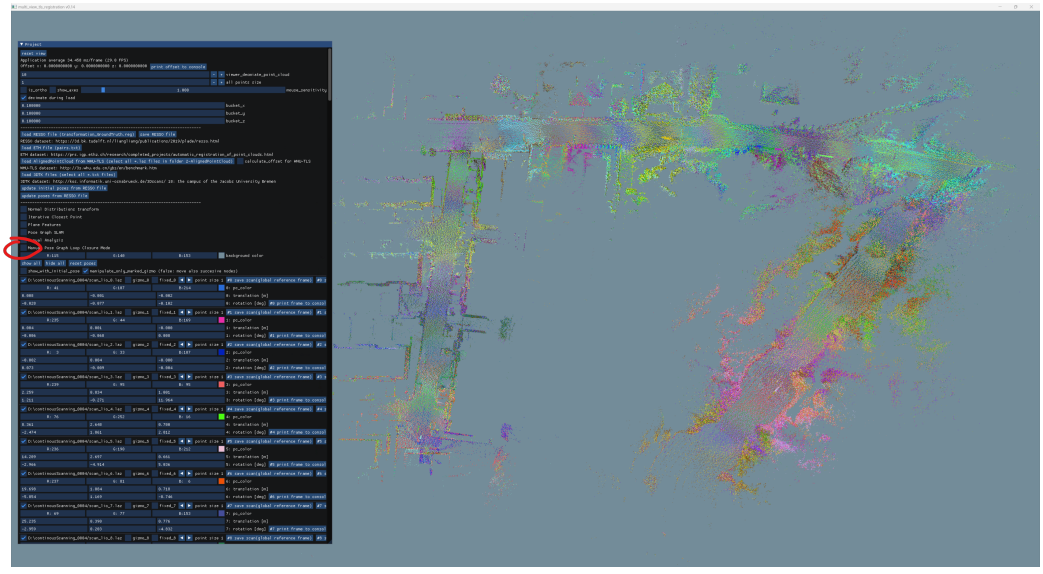

Figure 3.7: Turn off Manual Pose Graph Loop Closure Mod and inspect if everything is ok, if not, repeat steps from figures 3.3-3.6 (choose another pair of scans, refine them and compute the pose graph SLAM).

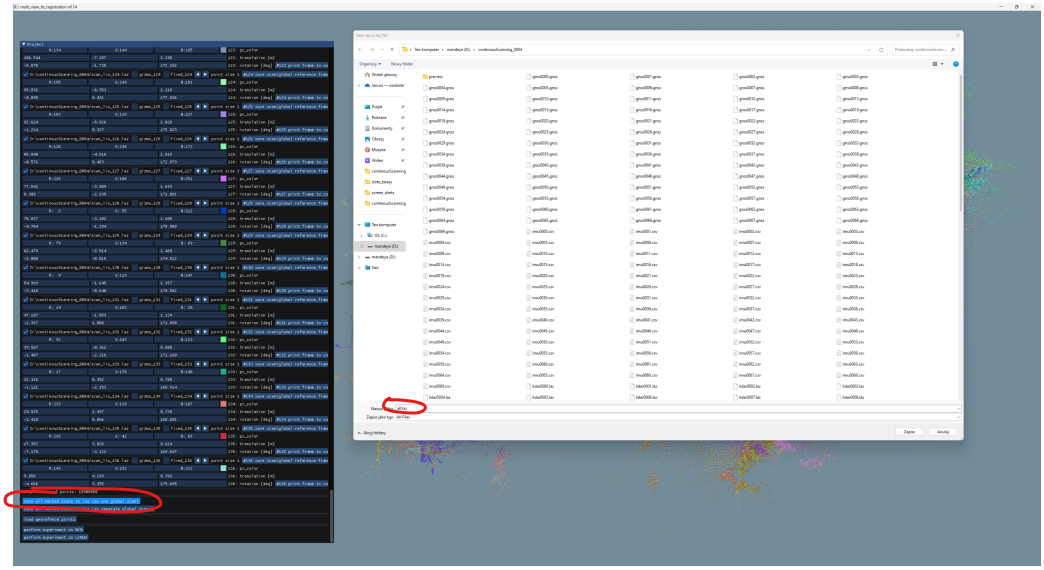

Figure 3.8: Once the job is done export data to *.laz. This is Your map that can be loaded by e.g. CloudCompare.

3.2 Step 3

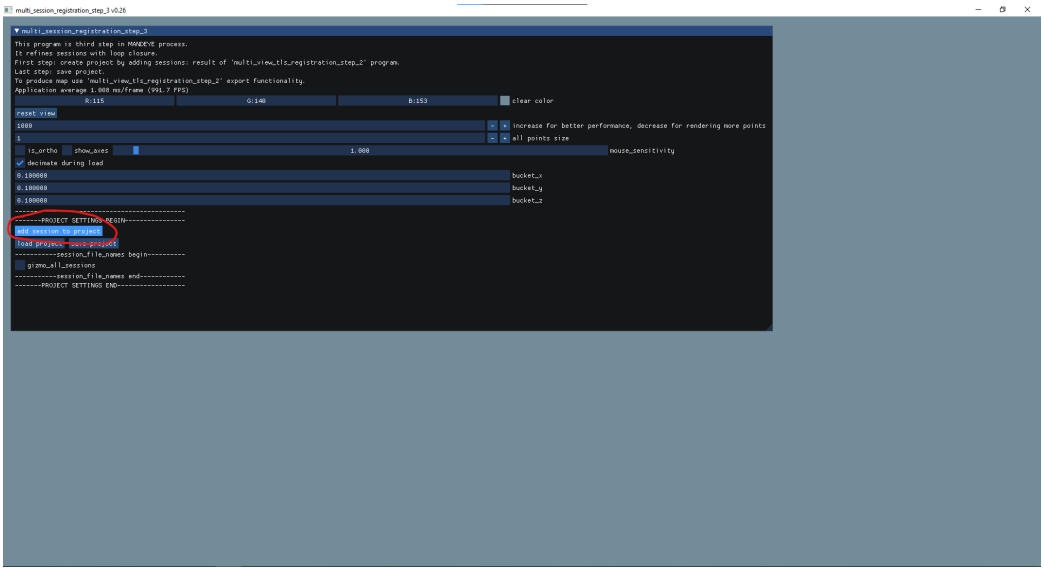

Figure 3.9: Add sessions that you want to align.

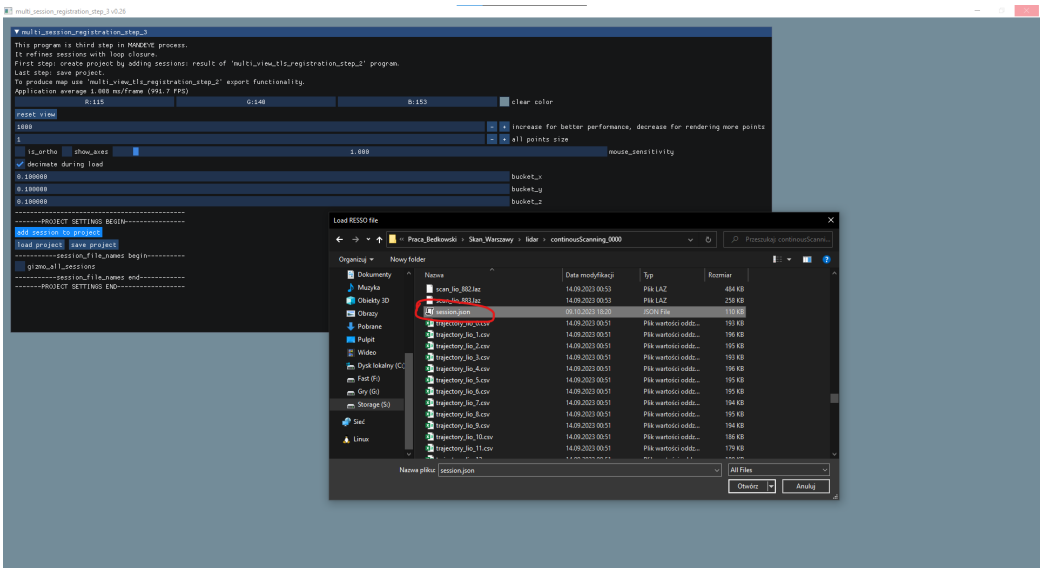

Figure 3.10: Choose session.json files - effects of the lidar odometry step.

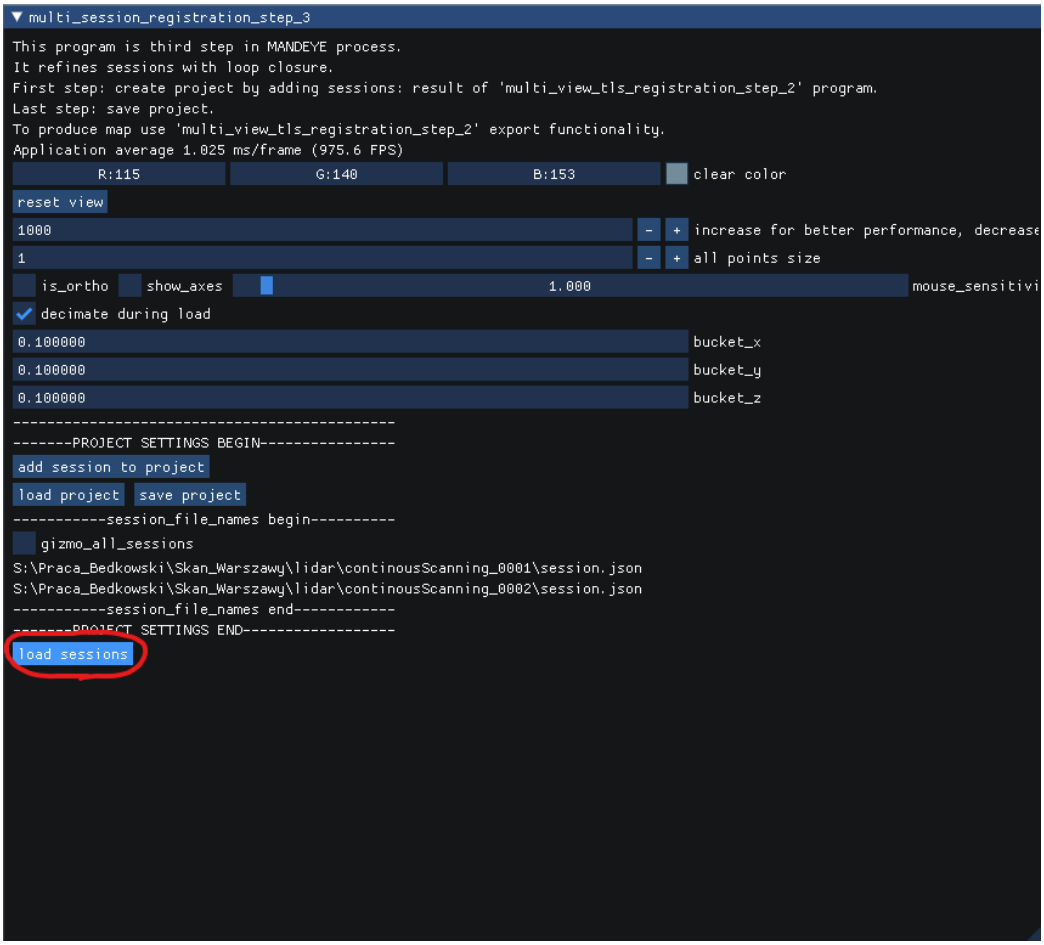

Figure 3.11: Click load sessions button and wait for the chosen sessions to load.

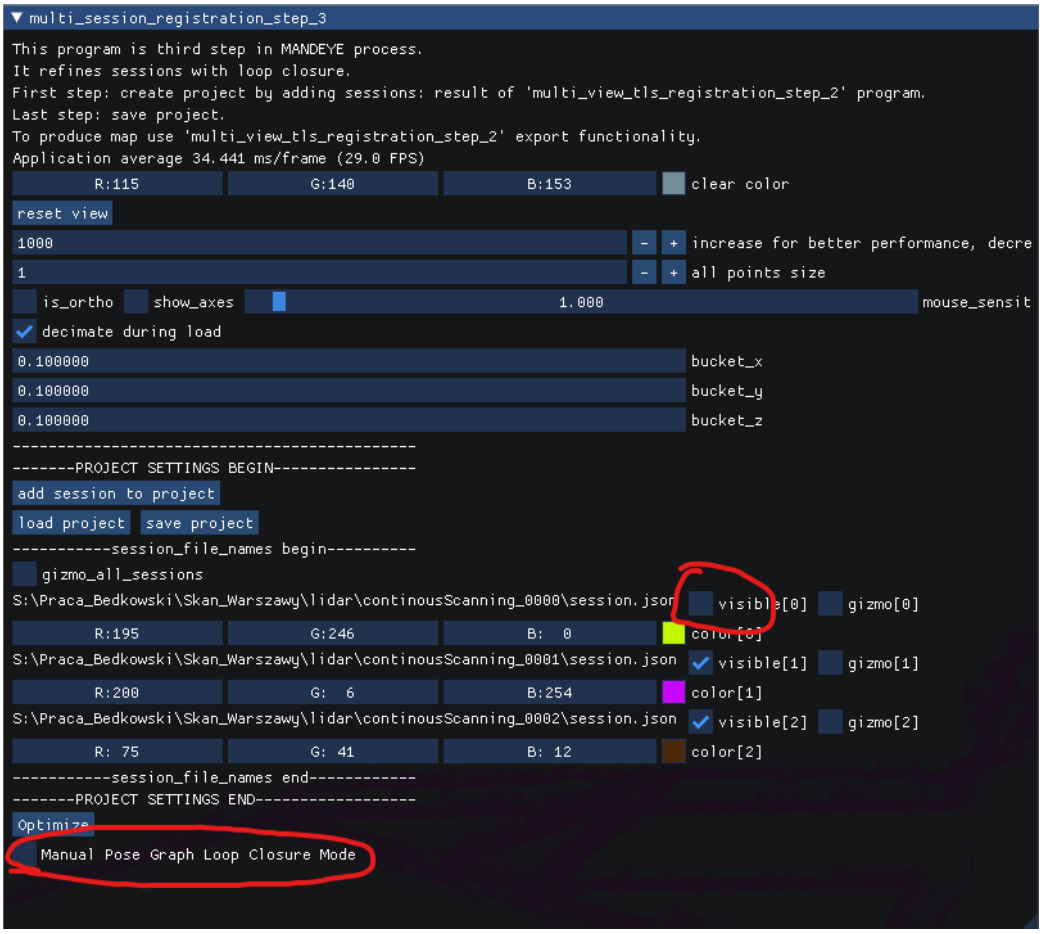

Figure 3.12: When all of the sessions have loaded activate Manual Pose Graph Loop Closure Mode. If more than 2 sessions were loaded, deactivate sessions till two of them remain. After that the button should appear.

Figure 3.13: Choose 2 individual scans of the same area, one from the first session, other from the second session and click add edge.

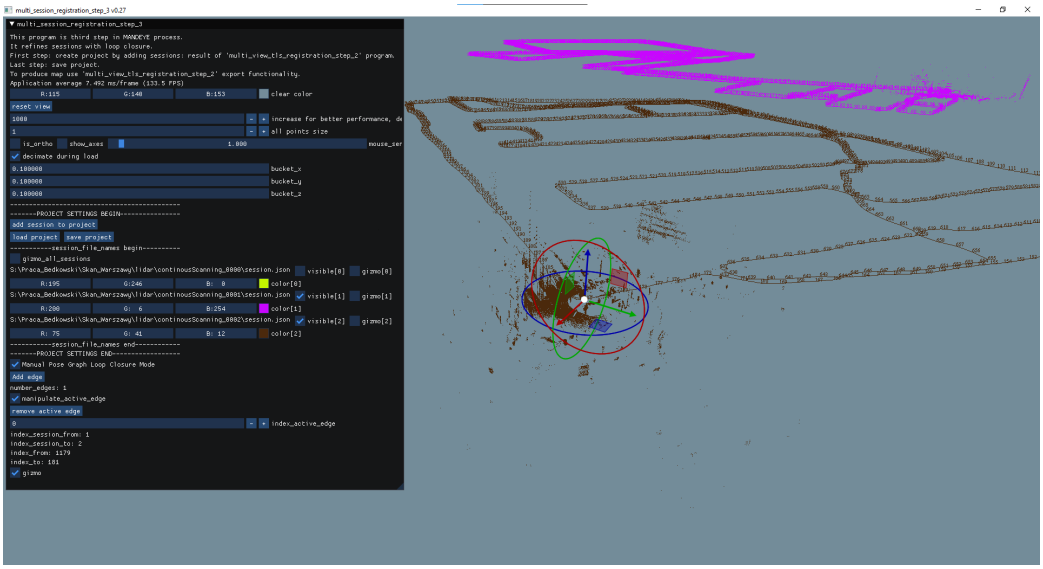

Figure 3.14: Click manipulate active edge, then gizmo and as in the step 2 align scans as precisely as possible and then repeatedly use ICP till nothing changes.

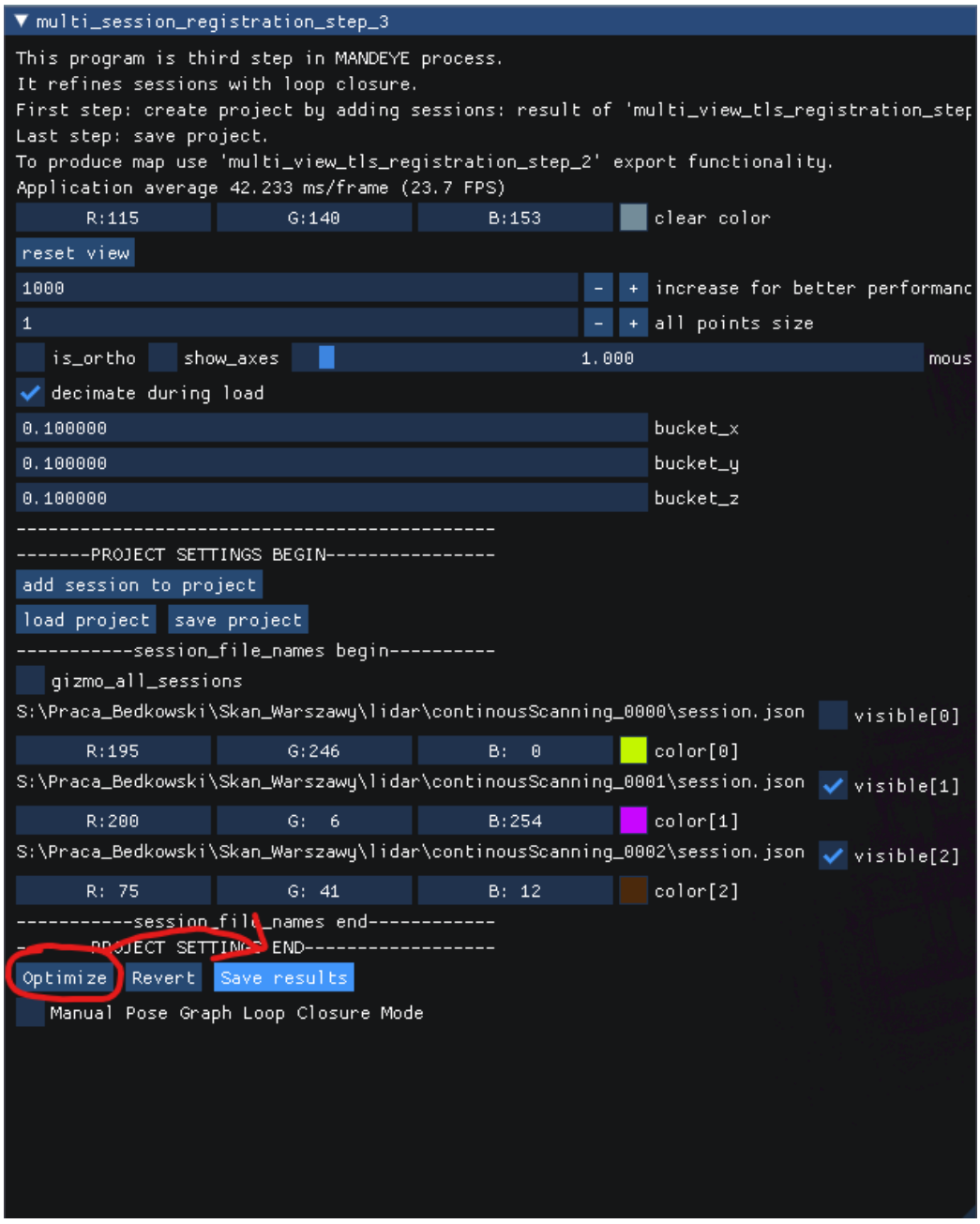

Figure 3.15: After aligning scans turn off Manual Pose Graph Loop Closure Mode, click Optimize and if everything is ok then click Save results. Should anything go wrong and sessions haven't orientated as planned just use Revert button. Repeat steps 3.13-3.15 until two sessions are aligned with a satisfying effect.

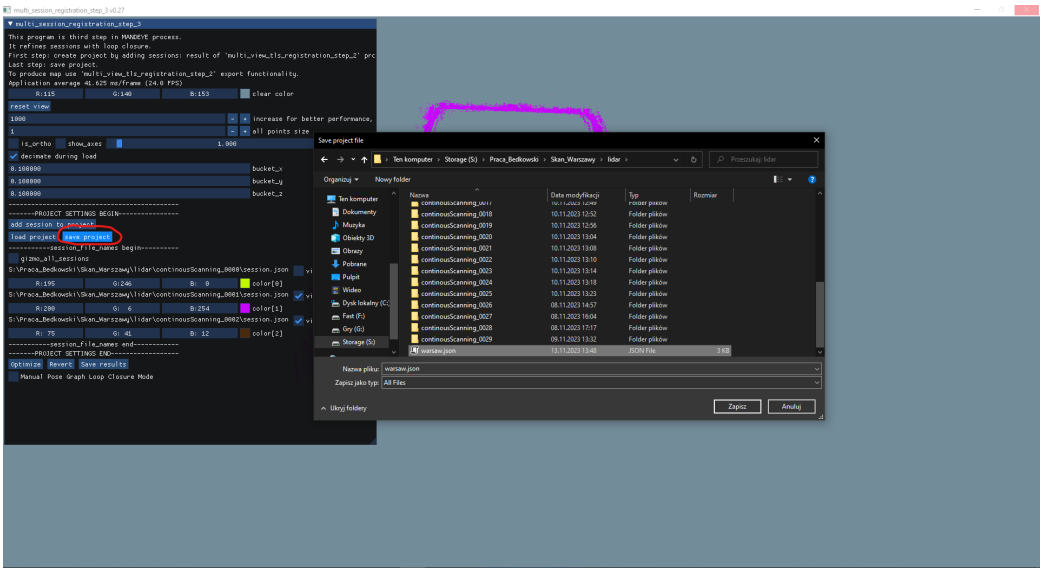

Figure 3.16: At the end or in the middle of work you can save your project to .json file, which can be loaded next time multi session registration step 3 is used.

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.