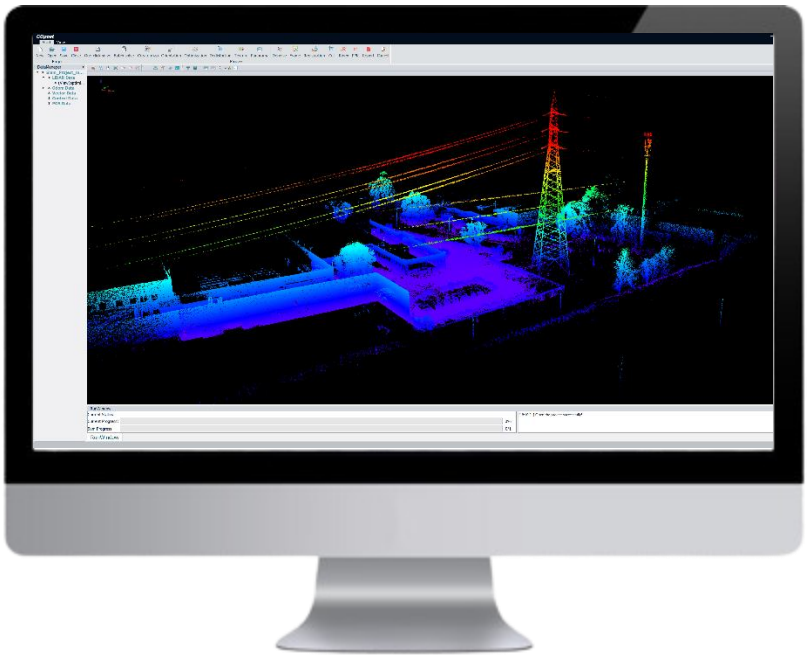
STONEX

STONEX® GO*post*

SLAM Processing Software

User Guide



(February 2024)-Ver.1.0

GOpost v58

www.stonex.it

Contents

Changelog

GOpost	
Version 58	• X70GO processing integration. • Possibility to post-process GNSS data and use them in Orientation step. • Writing log files after data processing. • Changed the filter that now deletes all objects in motion.

	• Added trajectory and panoramic images that can be opened in GOpost after orientation. • Fixed report for non-rigid orientation. • Added GCP coordinates after orientation in report. • Added check on correctness of input path. • Fixed some known bugs.
Version 57	• Fixed bug related to fast algorithm. • Added colorbars for elevation view. • Improved colorization algorithm. • Added refine_pos in colorization tool.
Version 56	• Added buttons for calculating angles and areas within the point cloud. • Added the "travel" button in the "view" window, which allows automatic navigation of the cloud based on the trajectory travelled. • Added an allign button in the 'edit GCP' window that allows automatic alignment of points. • It is now possible to perform a non-rigid orientation based on coordinates in a local system. • After the mapping drift error, the screen will be cleared before starting a new calculation iteration. • In the pano folder, a file called 'pano_pos_geo' will be saved with the coordinates of the panoramic images in a georeferenced system (after cloud orientation). • Added a 'report' button that allows the orientation report to be opened directly within gopost.
Version 55	• Fixed a bug in Japanese systems that caused the point cloud to be oriented backwards. • Added the ability to change the size of the points in the displayed point cloud

1. Legal Notice

1.1 Copyrights and trademarks

STONEX®, the STONEX® logo, X70^{GO} and X120^{GO} are trademarks of STONEX® S.r.l.
STONEX® GO*app* and STONEX® GO*post* are trademarks of STONEX® S.r.l.
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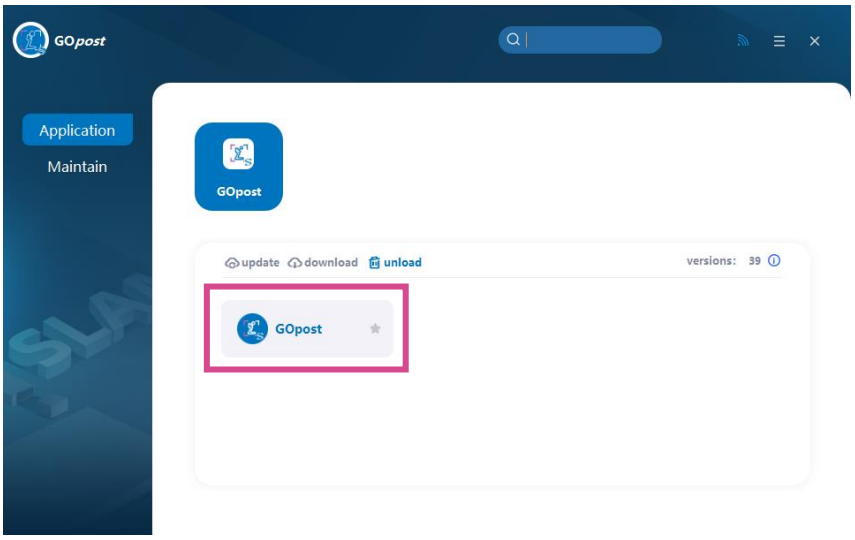
2. GO*post* software

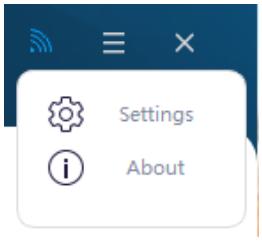
GO*post* software can post-process the data collected by X120^{GO} and X70^{GO}. It can produce high-precision point clouds, optimize point cloud results, color the point cloud, orientate it and produce local panoramas. You can also browse the point cloud and perform registration between different datasets. The final result can be exported to other platforms in .las format.

1. Download on PC from here: GO*post*
2. Follow the installation procedure.

When you click on the GO*post* icon, the following page is shown. To open the software, click on its icon.

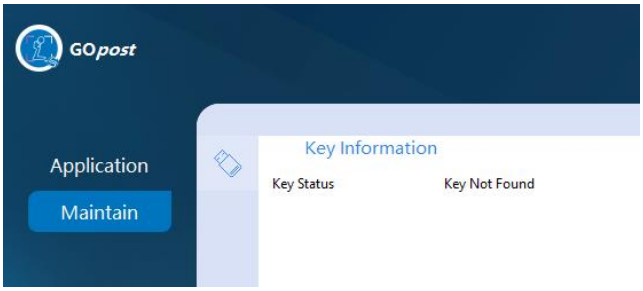


If you want to change software language, click on ☰ and *Settings*: English, Italian and Chinese are available.



Select *About* to check software version

USB dongle license is provided in the carrying case. If the dongle is not inserted, the software cannot process the data properly. Check license status from *Maintain* page.

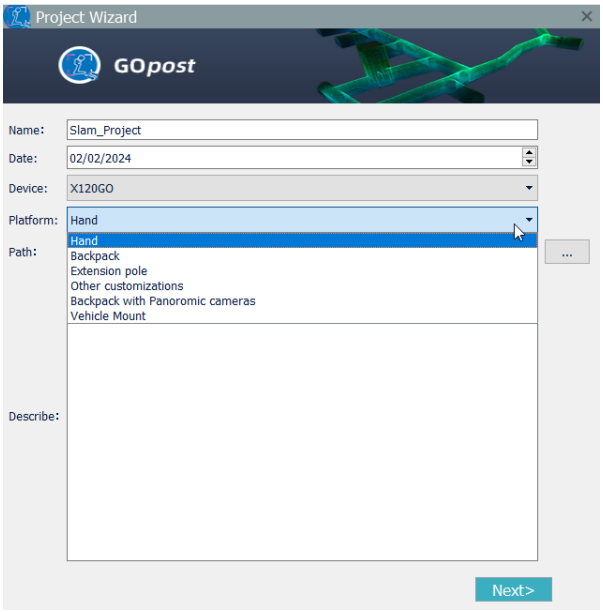


2.1 New project

Click *New*, set the project name, choose the device between X120GO and X70GO.
Choose the platform correct platform for your processing.

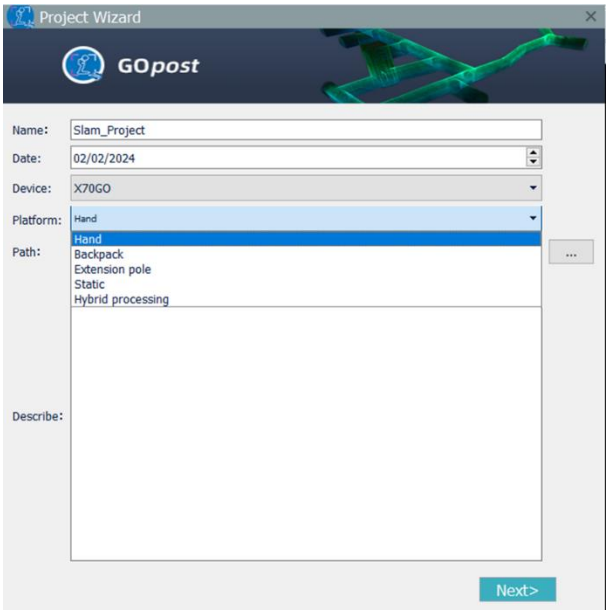
For X120GO:

- Hand: if you are working only with the scanner.
- Backpack: if you are using the backpack.
- RTK120GO: if you are using the RTK module.
- Vehicle mount: if the scanner is mounted on the vehicle mount.



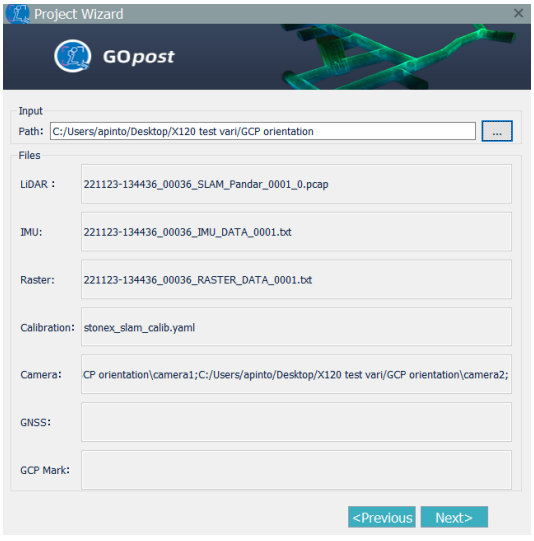
For X70GO:

- Hand: if you are working with the scanner and want to process only SLAM point cloud. Only SLAM algorithm will be used and will not consider static improvements.
- RTK120GO: if you are working with the RTK module.
- Static: if you want to process the point cloud but colorize only the static spots. Will cancel the SLAM data after the texture is applied.
- Hybrid processing: if you want to process SLAM and static data together. Will enhance the static spots inside the SLAM point cloud.



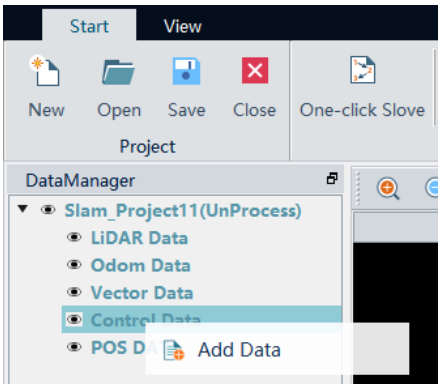
In Path select the saving path for the project, then click *Next*.

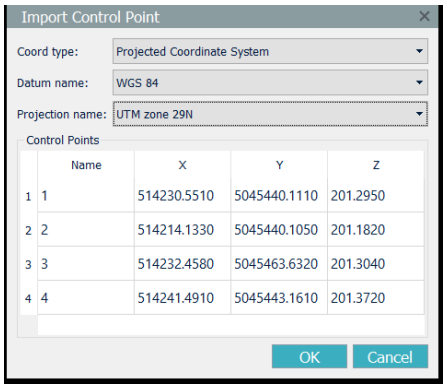
Select the folder path where the data file is located in the Input Path, that is the next lower path of the "SN_XXXXX", the software will automatically identify the data in the folder. Click *Next* and then click *Finish* to complete the project creation.



2.2 Import GCP

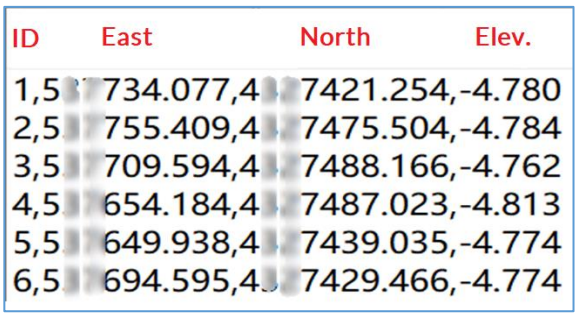
Right-click *Control Data* in the DataManager window, select *Add Data*, importing the organized GCP into the software. The software supports local coordinate system and the projected coordinate system.





NOTE: About GCP:

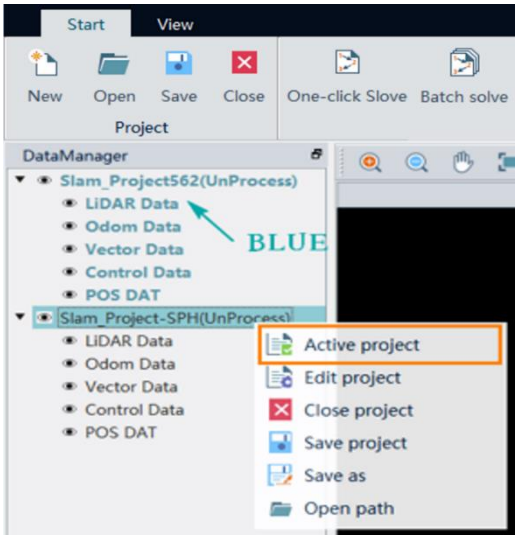
1. If there are no control points, you can ignore the step.
2. If you work with One-click solve the order of control points in GCP file must be consistent with the order and quantity of the scanner's actual acquired control points, otherwise the processing will result in an error in the orientation.
3. Is possible to perform orientation with the GCP at any moment of the elaborations.
4. The control point function does not support latitude and longitude for the time being and supports projected coordinates or spatial Cartesian coordinates. The control point file's format should be *.txt, in which contains four columns in order: ID, East Coordinates, North Coordinates, Elevation, separated by spaces or commas.



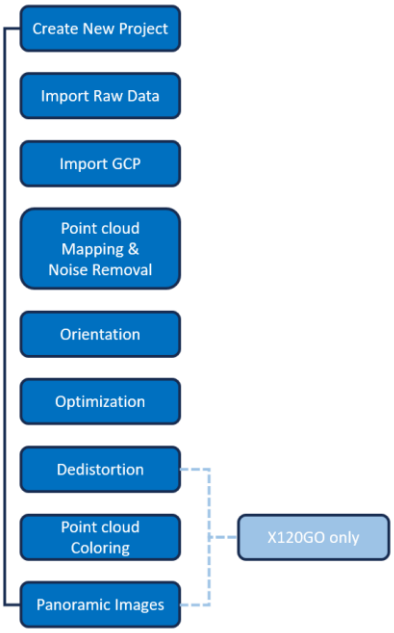
2.3 One-click processing

If there is only one project in Data Manager, the default status of the project is active, and the colors of project words are in blue. User can process the data directly.

If there are two or more projects in Data Manager, the default status of the first project is active, and others are inactive and in black. Please activate the project before processing it.

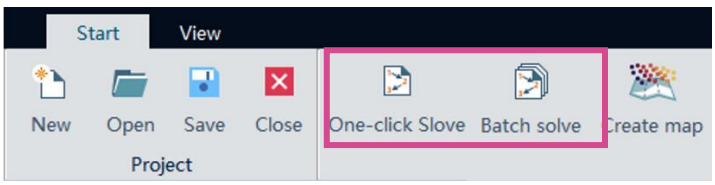


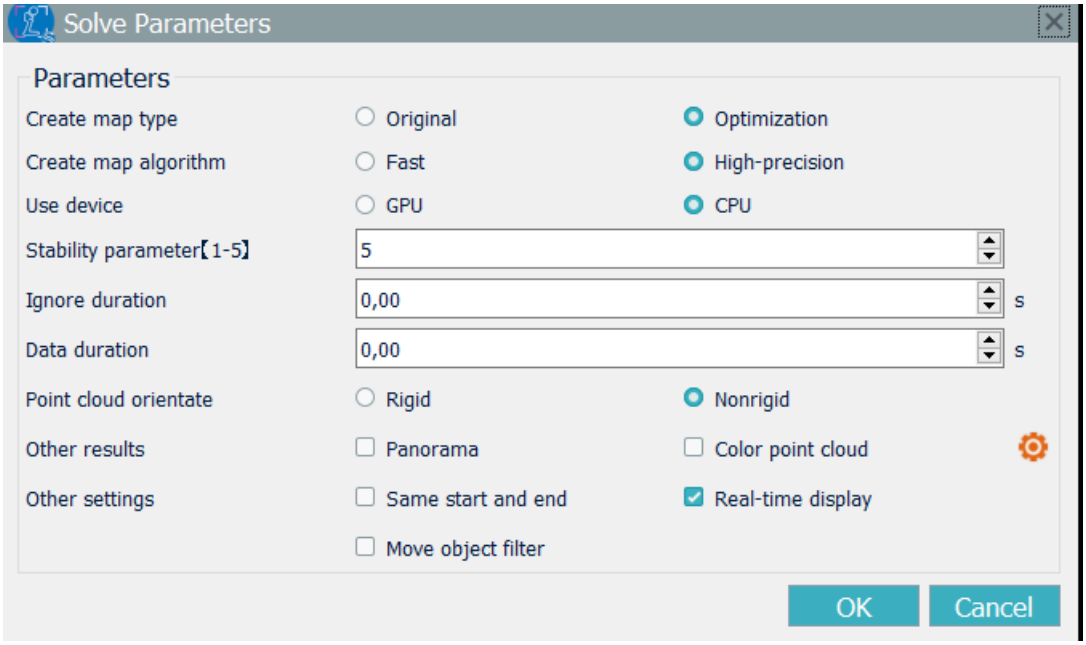
The software allows to elaborate data defining in a single window all the processing to do (like filtering, colouring, panorama calculation, and orientation).



You can do it for the active project only choosing *One-click solve*; or for all the project loaded using *Batch solve*. For instance, suppose you have 5 datasets, you can queue up to solve them with Batch solve, instead of processing one by one with One-click solve. When you use Batch solve, you don't need active project before solving.

Click *One-click Solve* or *Batch solve* in the data processing toolbar to set the Solve Parameters. The meanings of the parameters are explained as follows.





Create map type:

- *Original*: The only output is the original point cloud.
- *Optimization*: The outputs are the original point cloud and optimize the original point cloud, with denoising and thinning.

Create map model:

- *Fast mode*: In this mode, the software reconstructs the point cloud with a faster algorithm and in a more flexible way. This mode should be used in difficult environment (for example tunnels or open fields) or when the elaboration with High precision fails.
- *High-precision mode*: In this mode, the software reconstructs the point cloud in a more rigid way, taking a time like the acquisition one. This method should be used always at first in the most common environment like indoor environment or outdoor environments with many features presents.

Use device: Refers to the hardware equipment used by software to process data. The software uses the CPU by default. So far, the GPU has only been used for stitching panoramas.

Stability parameter: This refers to the degree of variability of the scanning scene, not the stability of the instrument at the time of scanning. If the Fast-precision algorithm is used, the parameter must be low, 1 or 2. If the high-precision algorithm is used, the parameter can vary from 5 to 3. We suggest leaving it as 5 and lower it only if the final result show oddities.

NOTE: If the mapping fails for a drift error, the software will automatically restart the process by lowering the stability parameter.

Ignore duration: The software will ignore the first X seconds of the data acquired.

Data duration: This parameter is combined with the Ignore duration to solve the point cloud data of any time the user defined. For example, if the user wants to solve data for 10-70s, the ignore duration is 10s and data duration is 60s. If you leave it at 0s, the software will process all the data.

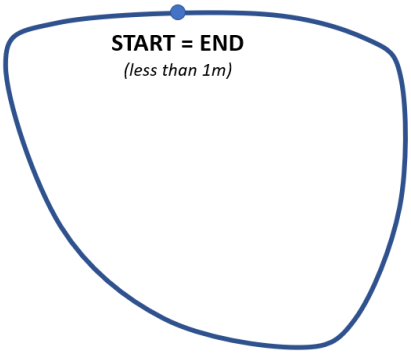
Point cloud orientate: Point cloud orientation includes rigid and non-rigid transformation. In non-rigid transformation, GCP will permit elastic compensation for point cloud to improve accuracy.

Other results: Choose if generate a Panorama or a textured point cloud.

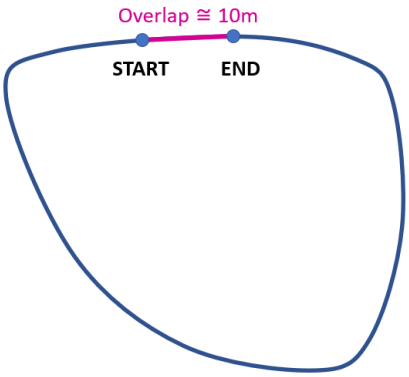
Other settings:

- *Same start and end*: There is no need to select this checkbox when solving. Select it **only** if you

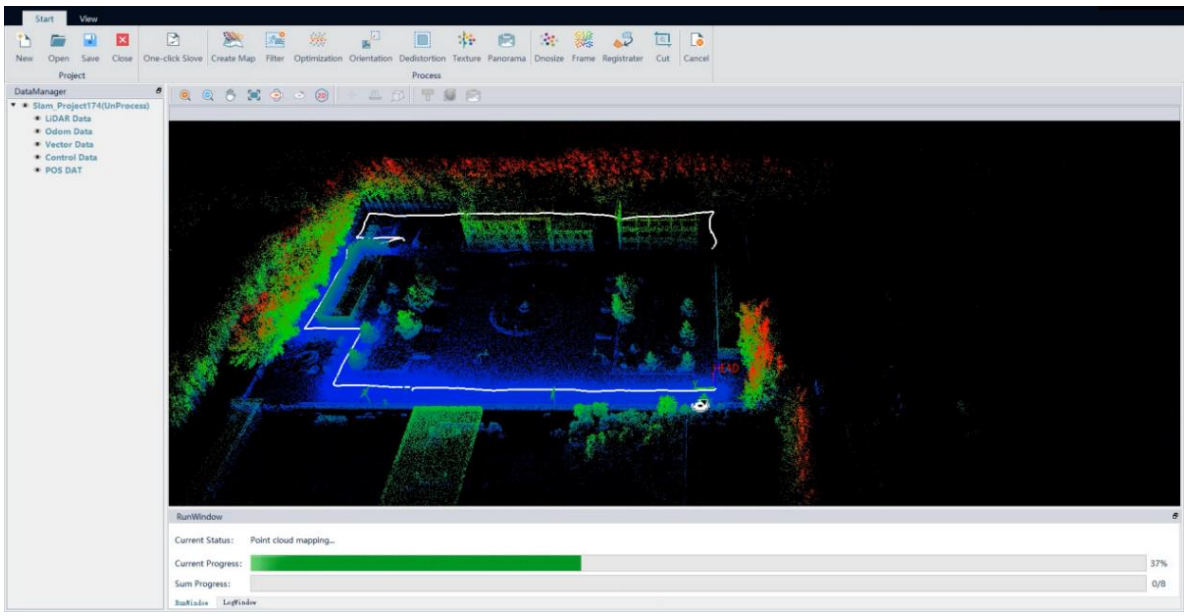
collected data closing a loop (difference between start and end point is **within 10 cm**).



With an overlapping between the starting point and the endpoint around 10 meters, the software automatically recognises the closure: do not tick the option "Same start and end".



- *Real-time display*: Display the point cloud mapping process in display window.

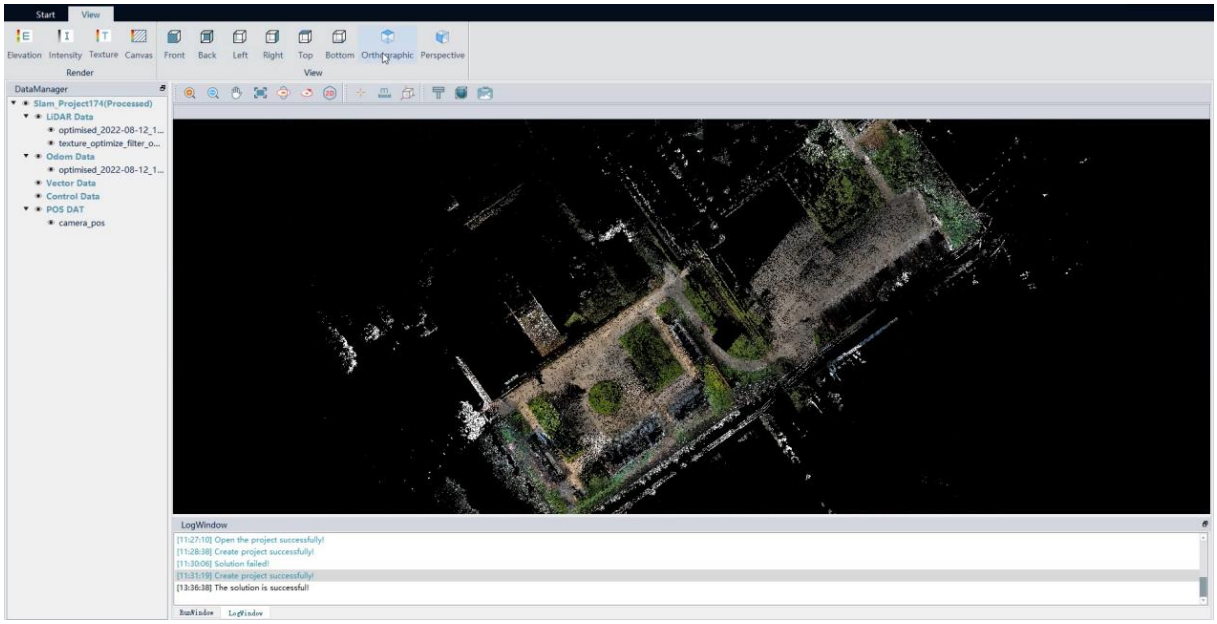


- Move object filter: this version of the filter will try to remove all the moving objects noise present in the point cloud. This step can only be done during the map creation. It can take some minutes to be applied, depending on how much moving noise is present in the point cloud.

Steps

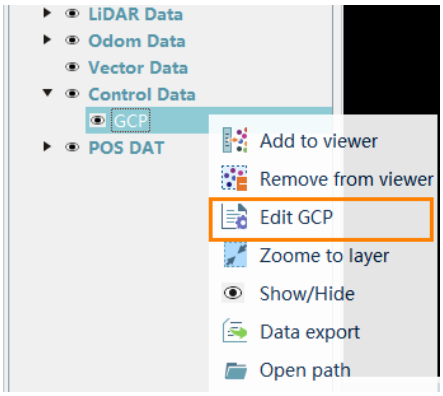
- **Point cloud mapping**: Create the point cloud from the raw data. You can filter it and optimize the result by removing noise.
- **Panorama**: A panorama image from single distortion-free images.

- **Point cloud colouring**: Colouring based on single distortion-free images. This procedure isn't related to Panorama function.



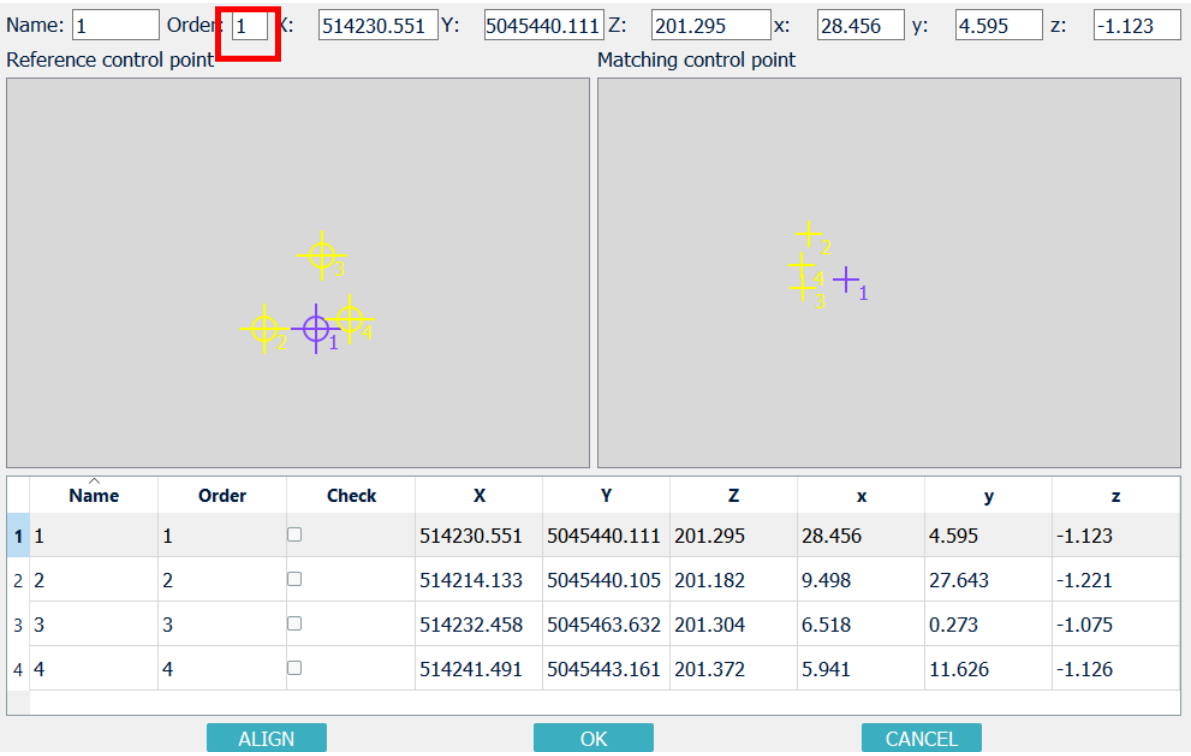
2.4 GCP Edit

If you import GCP when the project is created, and the point cloud is not orientated after data processing, you need to use the GCP edit function. Right click on the GCP file name and select Edit GCP.



In this window you can check the order between the points you saved with the scanner (on the right) and the points loaded in the project (on the left).

To automatically align the points, press the Align button. The software will try to find the most correct order between the loaded points and the points saved by the scanner. If the automatic alignment is wrong, you can manually modify the order of the points by selecting a couple and modify the order number in the upper part of the window.



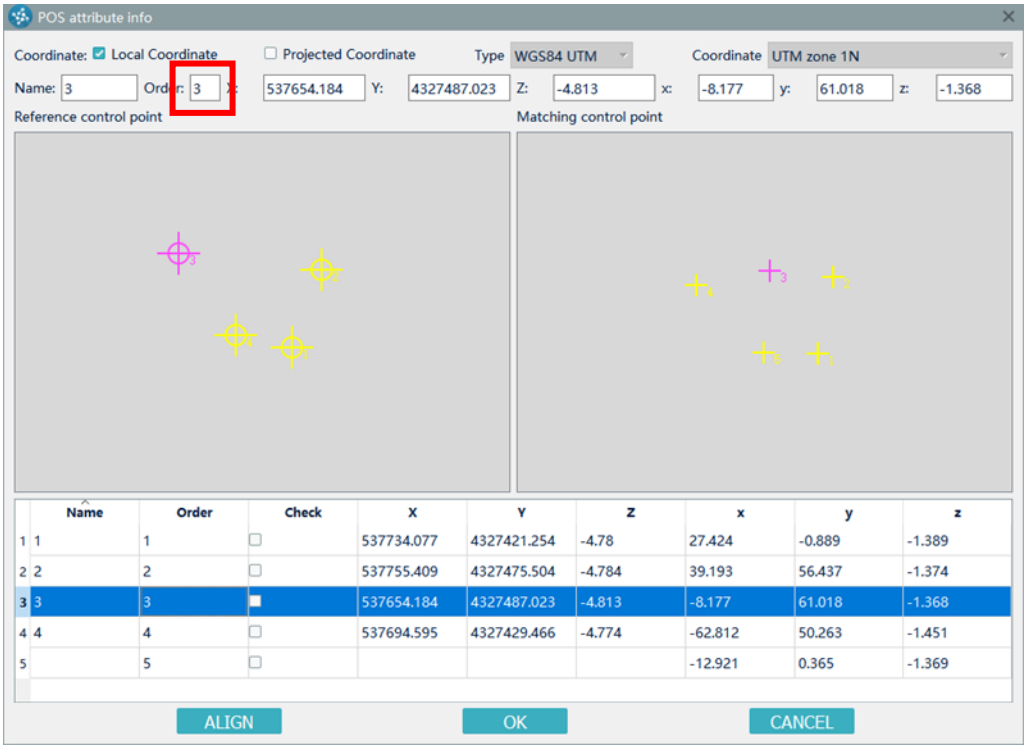
	Name	Order	Check	X	Y	Z	x	y	z
1	1	1	☐	514230.551	5045440.111	201.295	28.456	4.595	-1.123
2	2	2	☐	514214.133	5045440.105	201.182	9.498	27.643	-1.221
3	3	3	☐	514232.458	5045463.632	201.304	6.518	0.273	-1.075
4	4	4	☐	514241.491	5045443.161	201.372	5.941	11.626	-1.126

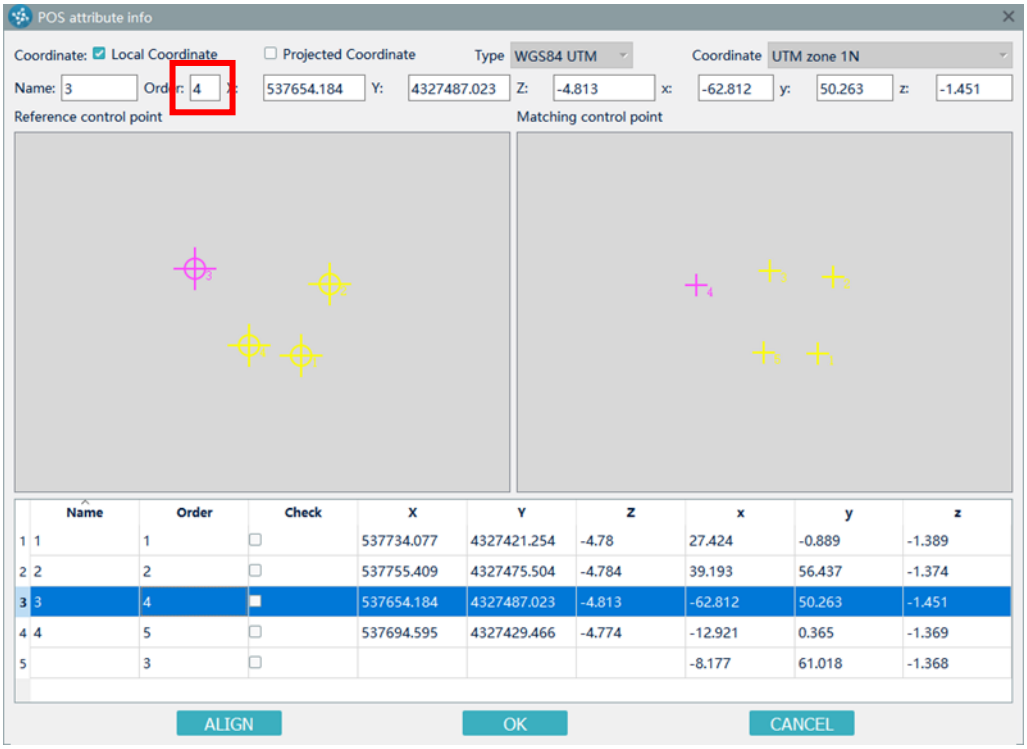
After the modification is complete, user can decide to consider some of the GCPs as a checkpoint. To do so, you can click next to GCP name and flag the check square. By doing so, the points checked will not be used in the orientation phase but will be evaluate the error on those points after the orientation.

There are two situations result in not-orientated points. We will explain them respectively. Right-click *Edit GCP* to enter the control point editing interface.

CASE 1: matching points are more than the control points. You can click the control point to be edited, modify the matching point sequence number at the upper toolbar, correspond the control point to the correct matching point, so that the excess matching point can be ignored at the end, and it will not participate in any calculation. Take figure below as an example, The correspondence between “GCP3” and “Matching point3” is

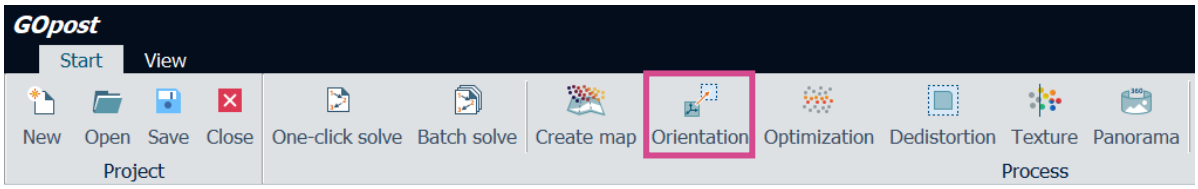
wrong, and the correspondence between “GCP 3” and “Matching point4” is correct. Select this pair of points, then modify the order number from 3 to 4.





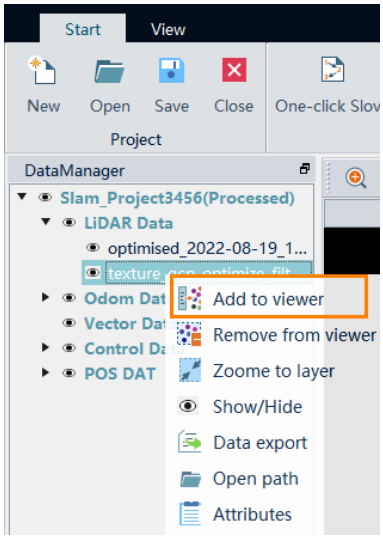
CASE 2: the number of matching points is less than the imported control point, user needs to edit the control point file and delete the surplus control points.

Click *Orientation* to orient the pointcloud. A report with errors will be generated after the process and will be available in the gcp subfolder project.



2.5 Add result to view

Select the point cloud data in DataManager, right-click, and select *Add to Viewer* to add the point cloud to the display window. Other results can be viewed the same way as well.

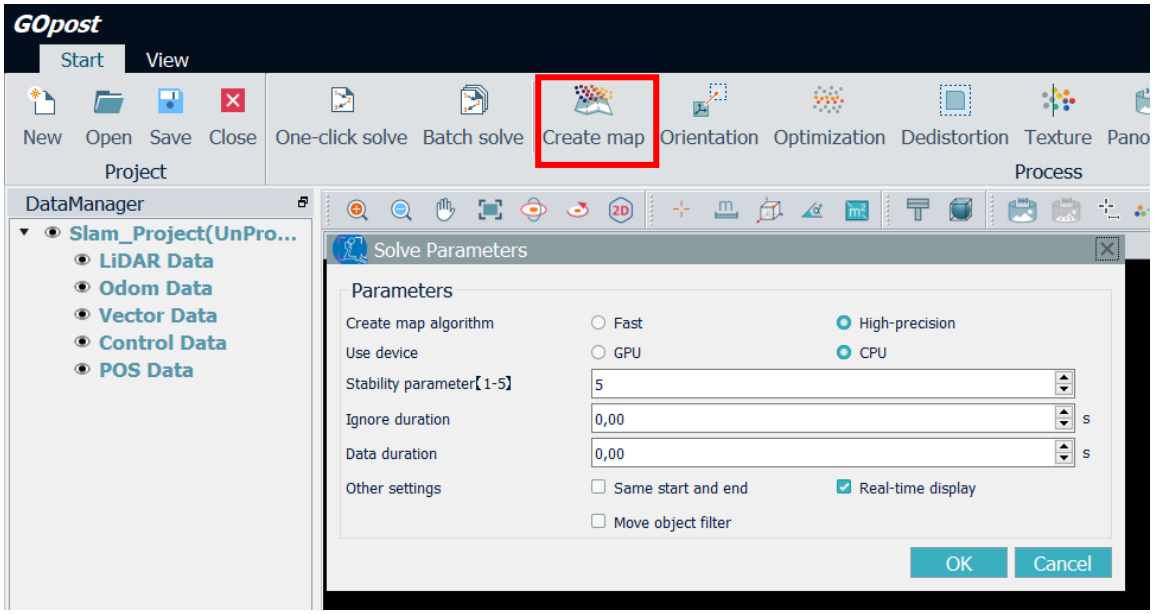


2.6 Step-by-step processing

The purpose of step-by-step processing is to give user choices to select the corresponding processing steps according to the needs. Can be done in different orders.

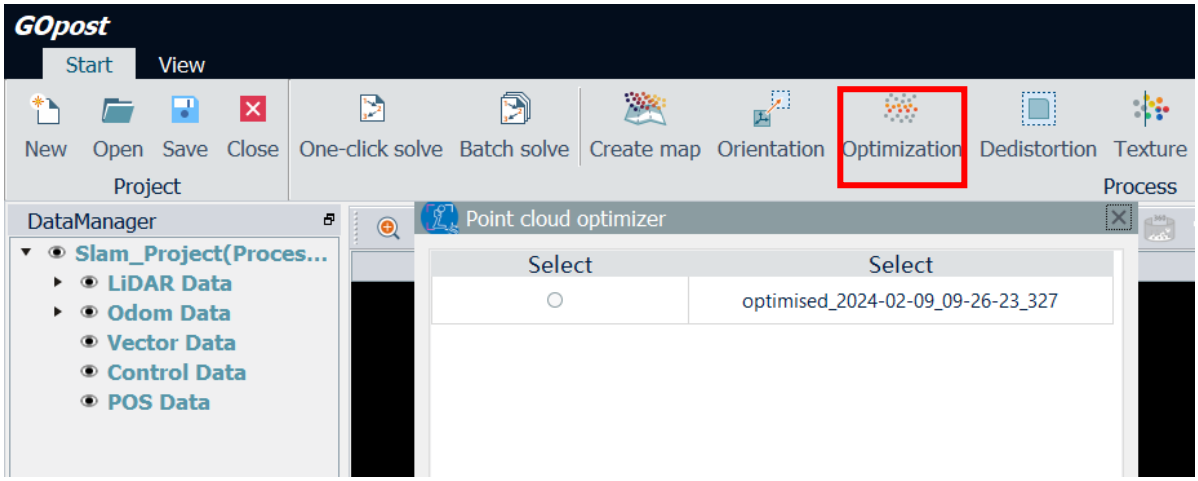
Create map

Activate the project, click *Create map*, select the algorithm type, and set the parameters; click OK to start the calculation. This step is to generate original point cloud. Therefore, it may contain some noise. If you select *Move object filter*, the software will remove the noise of moving objects. This filter can take some minutes to be applied, depending on the moving noise present in the point cloud.The processed result begins with a prefix 'optimised' in the file name under LIDAR Data in DataManager.



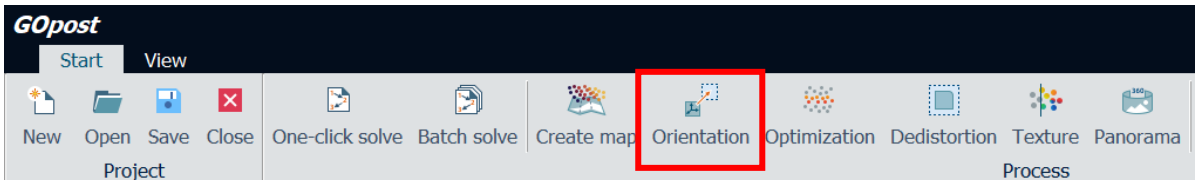
Optimization

This function will optimize and denoise the original point cloud to reduce the thickness of the point cloud and improve the accuracy of the point cloud. Click the Optimization tool and select the data you want to optimize. The optimize point clouds with prefix 'optimize' in DataManager are optimization result.



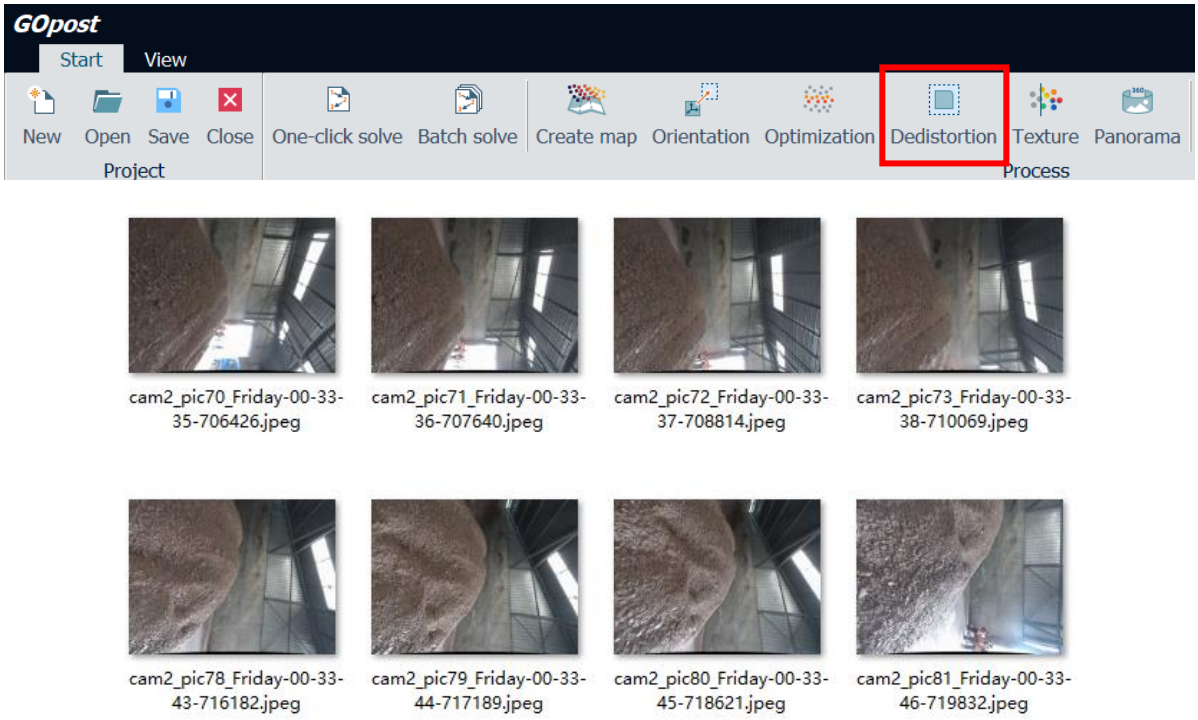
Orientation

This function transfers the point cloud to the absolute coordinate system in which the control point is located. Coordinate transformation is performed on the point cloud when the order and number between GCP and matching points are consistent. Orientation can be performed with rigid body transformation, which can be applied to any of the resulting point cloud, or with non-rigid body transformation, which will apply an elastic compensation to the whole project and will be applied only to the original point cloud..



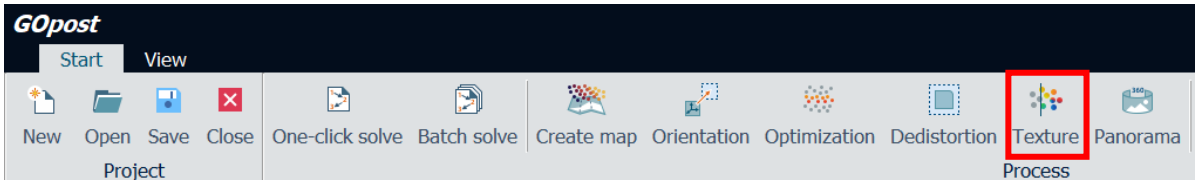
Dedistortion

This function is designed to remove distortion from the image, and this step is necessary for subsequent point cloud coloring and panoramas. A single undistorted image is stored in a folder named “dimage”. Not available with X70GO data.



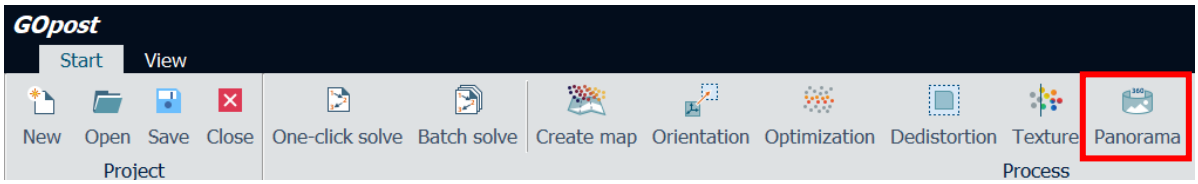
Texture

This function uses the undistorted image, or the video frame, to colour the point cloud. Click *Texture* in the data processing toolbar and select existed point cloud to perform point cloud colouring. Point cloud with a prefix ‘texture’ are coloured point cloud. The Refine Camera POS option should be checked only if the normal colorization did not work. Do not use it for X120GO data but should only be used with X70GO data.



Panorama

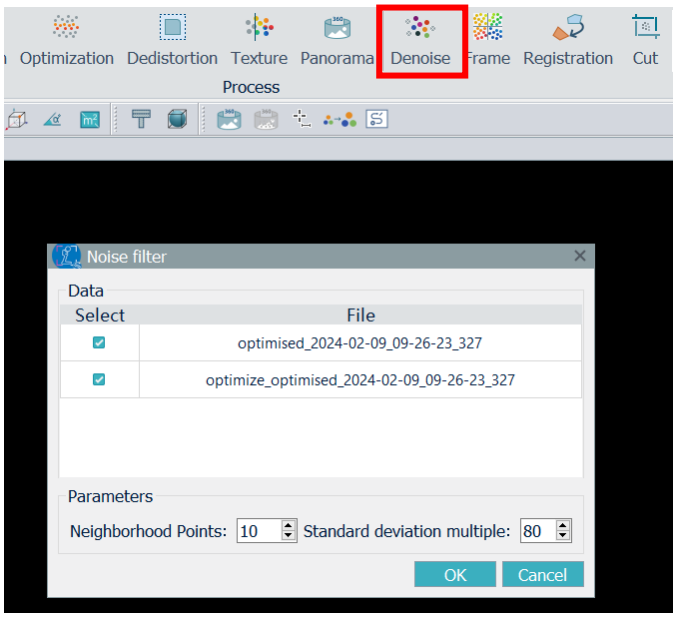
This function processes undistorted image to generate panorama. If you want to see panoramic images in georeferenced system, you need to use this function after you performed orientation. Not available with X70GO data.



2.7 Point cloud edit

Denoise

This function can remove noise by Statistical Outlier Removal algorithm. Select the point cloud you want to process and set neighbourhood points number and standard deviation multiple. The meanings of parameter are as following.



- Neighbourhood Points: This represents the required number of points within the neighbourhood to calculate the average distance and standard deviation from each point.
- Standard deviation multiple: This is the value multiplied by the standard deviation.

Frame

This function is for framing the point cloud.

The software will save different squares of point cloud with the dimensions that you set.

Select the framing method (scale bar or fixed size), prefix (will add a name to all the square), framing scale/ frame size (refers to dimension of the squares), expansion range and rang, etc. Then click *framing* to process the data in framing.

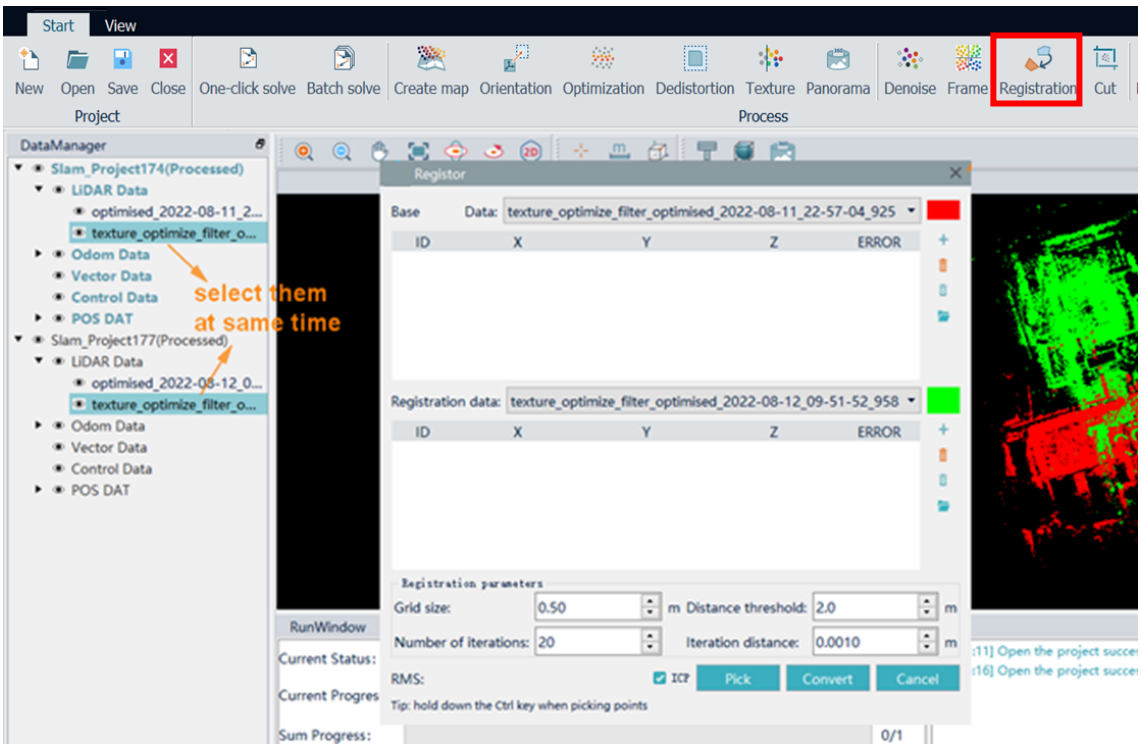
Registration

This function is used to put in the same reference system different point clouds.

Before point cloud registration, you need to add the basic point cloud and the registered point cloud to the display window.

There are steps of registration:

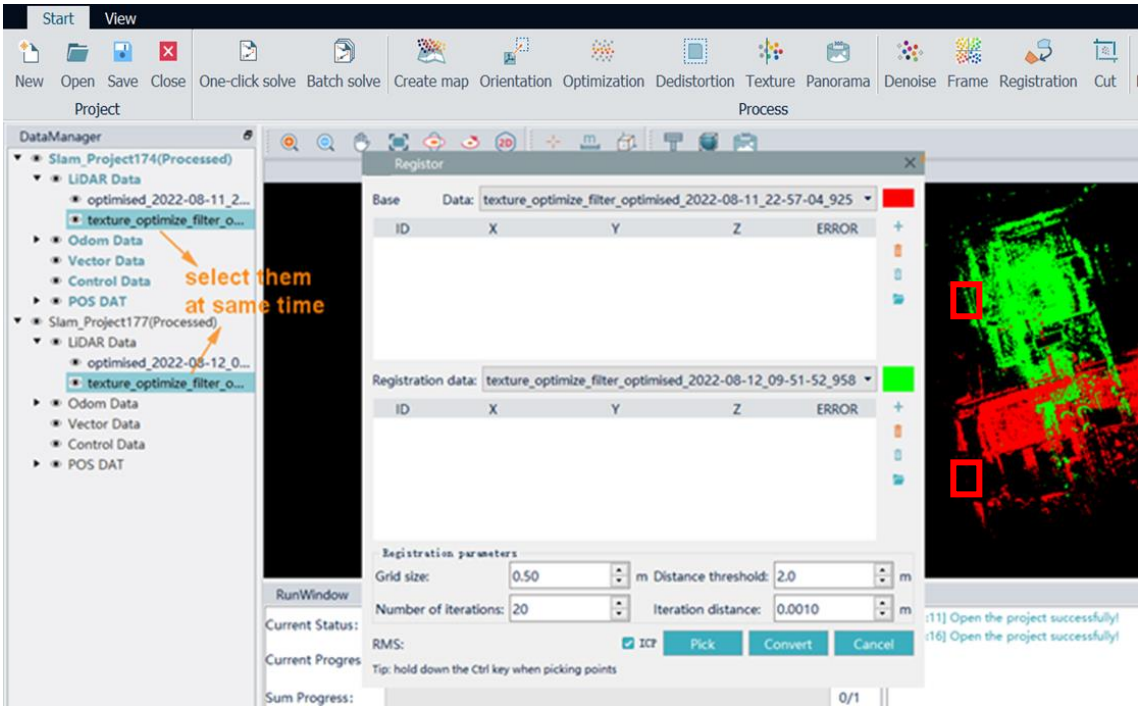
- Add reference point cloud and the point cloud you want to register to display window.
- Select basic point cloud and registered point cloud at the same time, then click *Registration.*



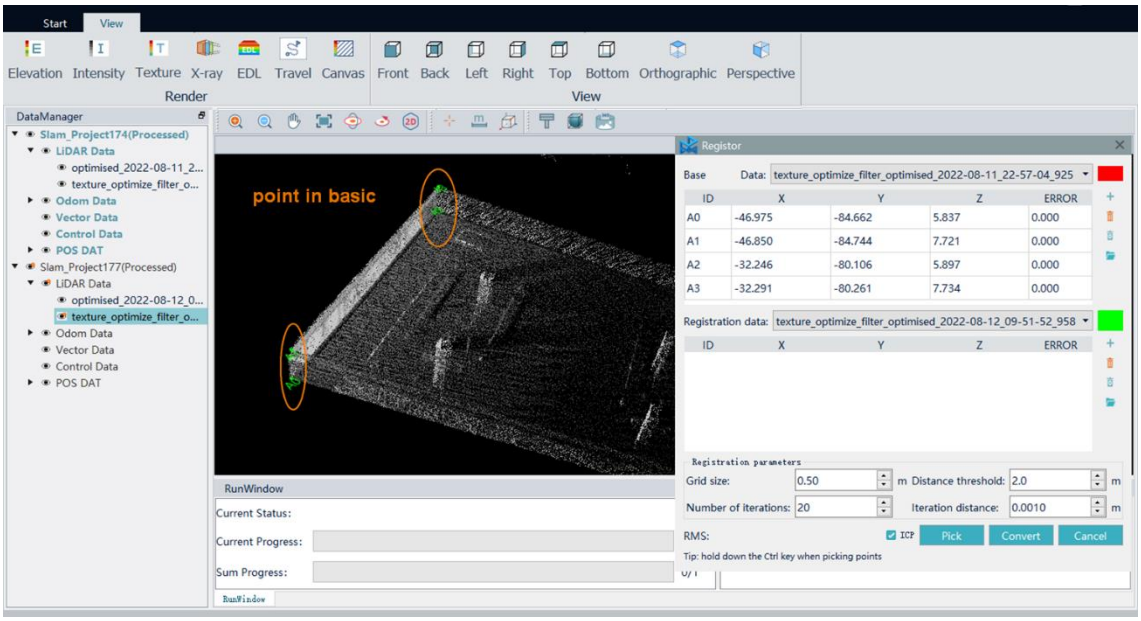
- If GCP (***Chapter 10.5*** for a guide to the acquisition of points) were collected during the acquisition with scanner, after the processing, in the GCP folder of the project will be present a file called

"local_benchmark.txt". Click on the folder icon in the registration window, to import this file with the GCP for each point clouds. Check that the order of the GCP is the same in both files. If the order is different, you have to manually modify the GCP file and then re-import it.

NOTE: if you acquired the GCP while remain still on the point, in the "local_benchmark.txt" the first GCP will be related to the initialization point. If you don't want it to be counted as a GCP, delete the point from the file.

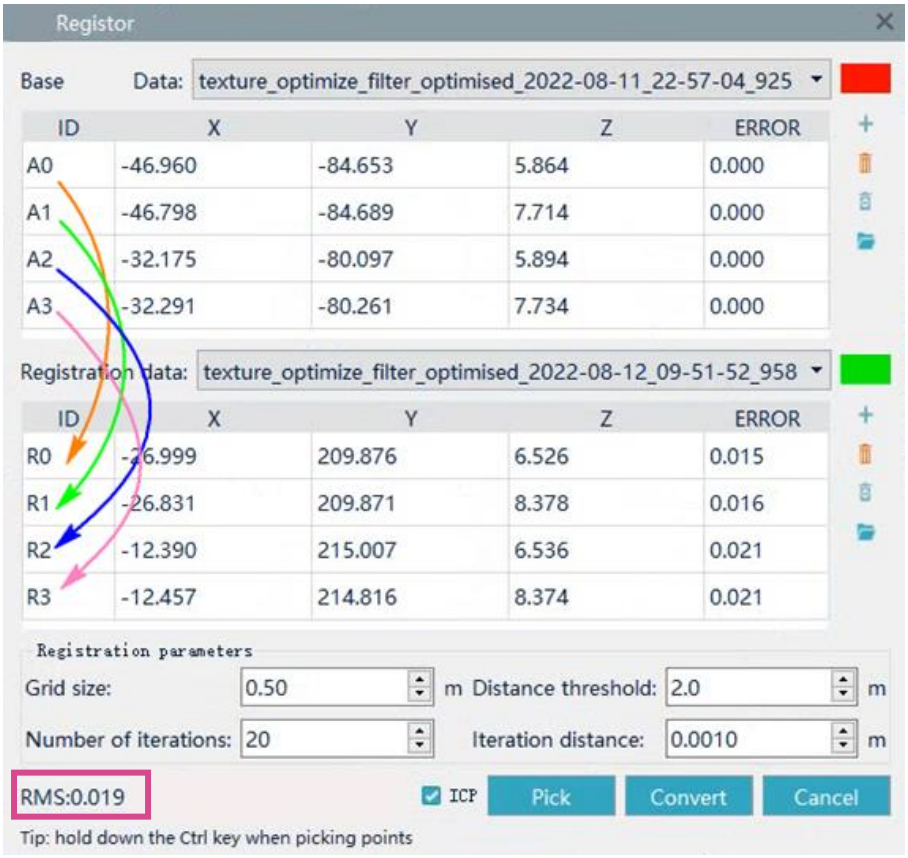


- If no GCP were collected, click *pick*， then select manually point pairs in basic point cloud and registered point cloud. The order of same name point must be consistent. In order to pick points, press Ctrl+left click of the mouse.



- Select at least 3 pairs of points with the same name in basic point cloud and registered point cloud, The order of same name point must be consistent.

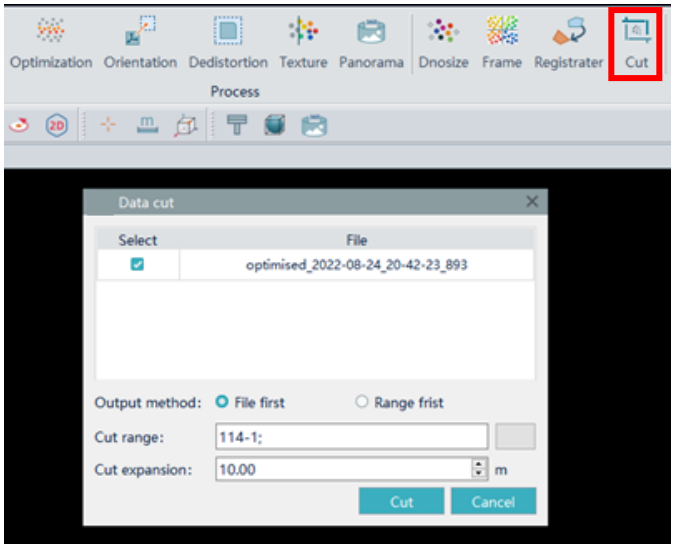
- Adjust the registration parameter (ICP), when registration RMS of error meets precision requirements, click *convert* to complete registration. The meanings of ICP parameter are as follow：
  1. Grid size: Point cloud tile grid size.
  2. Number of iterations: The number of iterations of the ICP algorithm, generally 20.
  3. Distance threshold: the maximum distance between points with the same name. If the searched matching point is greater than the threshold, it will not participate in the calculation.
  4. Iterative distance: the difference between the distances calculated before and after, if it is less than this value, exit the iteration.
  5. RMS is the root mean square error related to registration.
  6. At the end of the registration process, you will find a report with errors on the points in the folder of the project called *register*.



Cut

This function can clip the point cloud according to the range.

Select the data to be clipped, determine the output method, import the cropping range (vector files support shp, dxf, fmb, kml formats), and determine the expansion range.

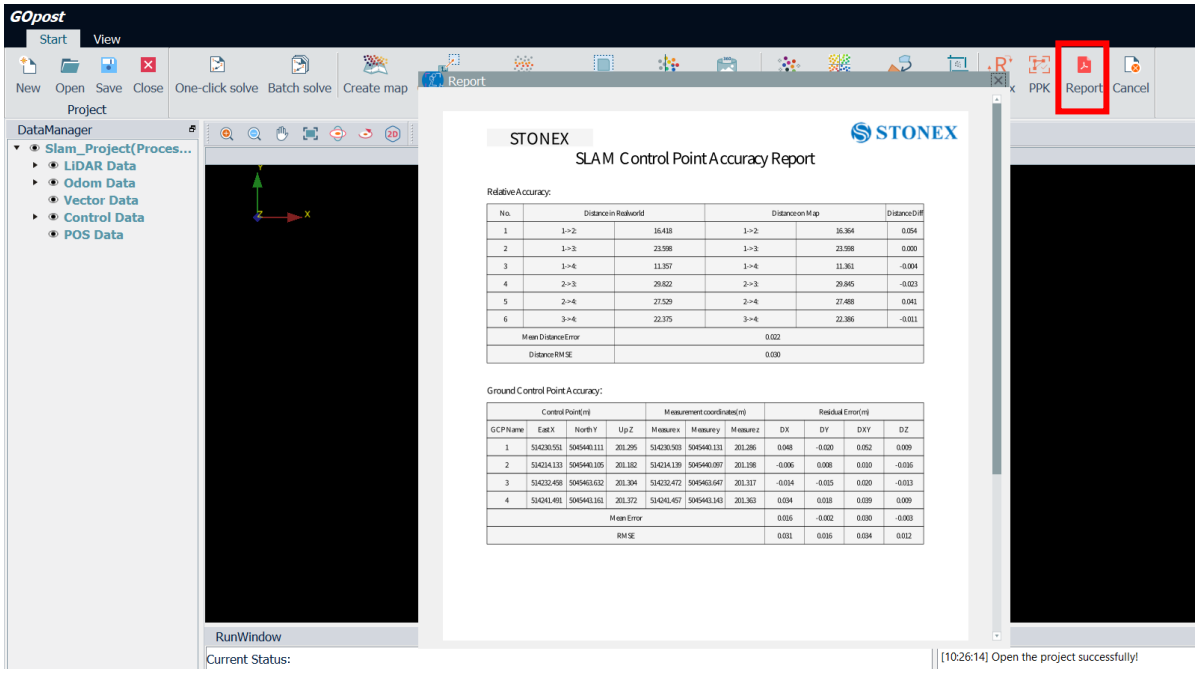


Rinex and PPK

See Chapter 3 for more information about those buttons.

Report

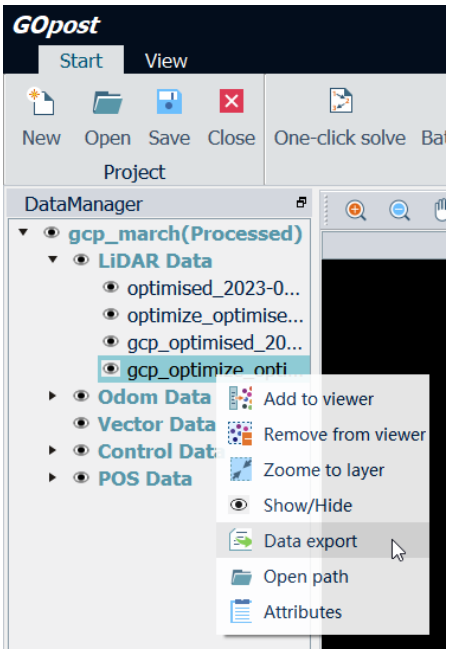
Press the report button to display the orientation report within GOpost. This function only works after orientating the cloud.



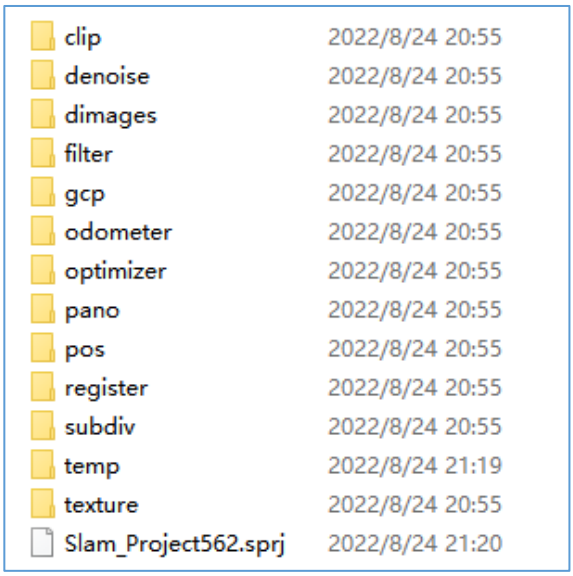
2.8 Data export

After the elaborations you will need to save the point cloud in a *.las format.

Open the LiDAR Data list, choose the result you want to save and right click on it. Then go to data export, in the next window you will be able to choose the name and path where to save the point cloud.



2.9 Description of the result catalog



- Clip: Clipped point cloud data.
- Denoise: Point cloud data after denoising.
- Dimages: Single image without distortion.
- Filter: Point cloud data after removing moved object.
- GCP: GCP files, oriented Point Cloud and orientation report.
- Odometer: Odometer data, in which HF_odometry.txt is the high frequency odometry, LF_odometry.txt is the sparse odometer, and optimized_odometry.txt is the optimized odometer.
- Optimizer: Point cloud data after optimization.
- Pano: panorama images and panoramic images position files.
- Pos: Image POS data, where camera_pos.txt is the image POS file, camera_trajectory.txt is the camera

trajectory file, lidar_trajectory.txt lidar trajectory file.

- Register: Point cloud data after registration and registration report.
- Subdiv: Point cloud data after framing.
- Temp: Project temporary folder, containing project information, original point cloud data and log. If users face problems, pls give log to Technical Engineer.
- Texture: Point cloud data after colouring.
- .sprj: Project file

2.10 Results browsing

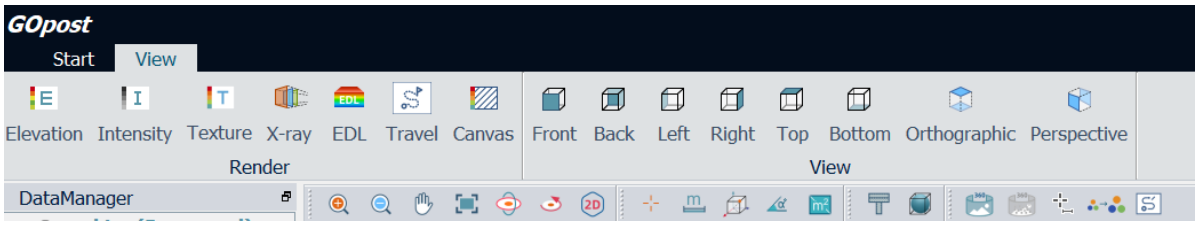
Select the point cloud you want to browse and right-click - Add to View.

User can change display methods that contain elevation, intensity, texture and canvas. In addition, user also can change display view angle, such as front, top, etc.

If you click on the elevation button, you can change between colorbars and set the minimum and maximum height reference.

An X-ray view and an EDL view are also available.

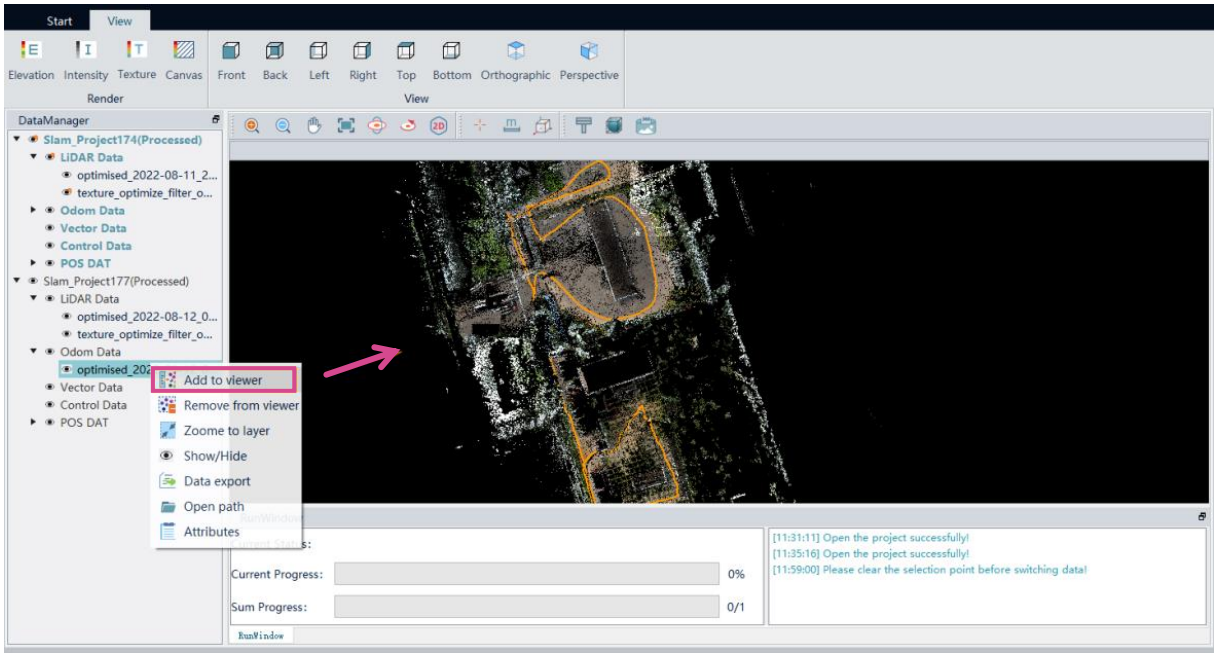
With the Travel button, an automatic cloud tour can be started based on the trajectory followed.



2.11 Trajectory

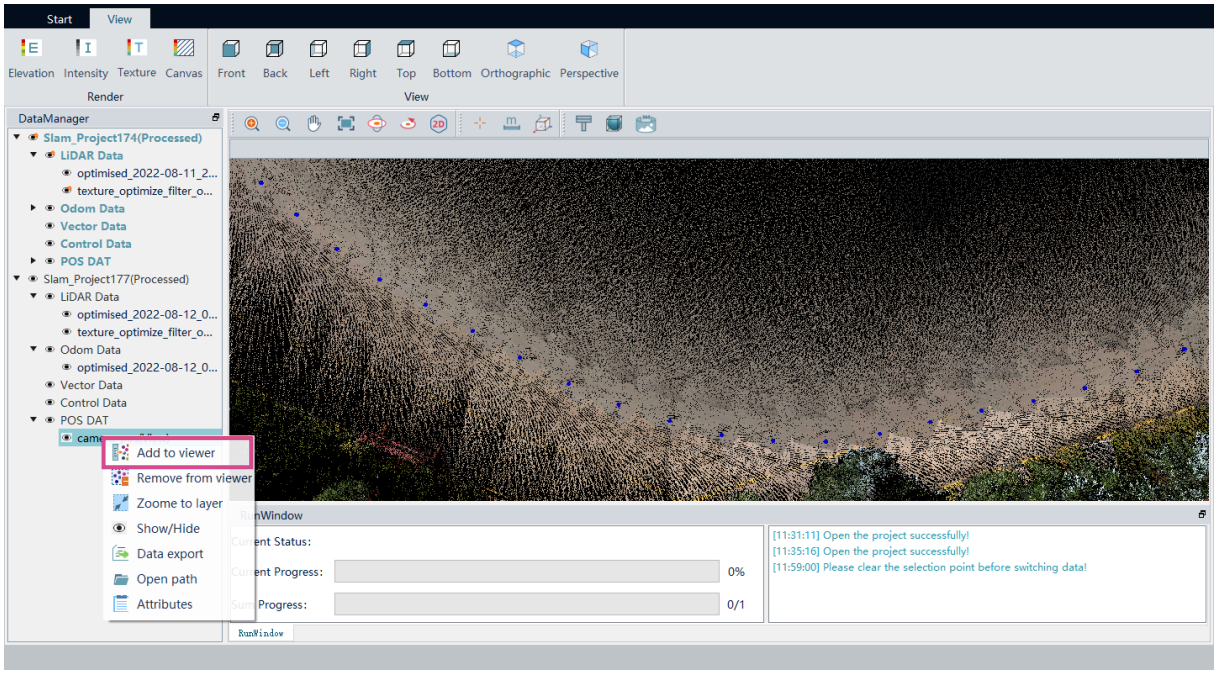
Select Odom Data and right-click - Add to Viewer. The points in orange are the odometer trajectory.

If you perform non rigid orientation, will be created also a file with the trajectory in the global reference system.

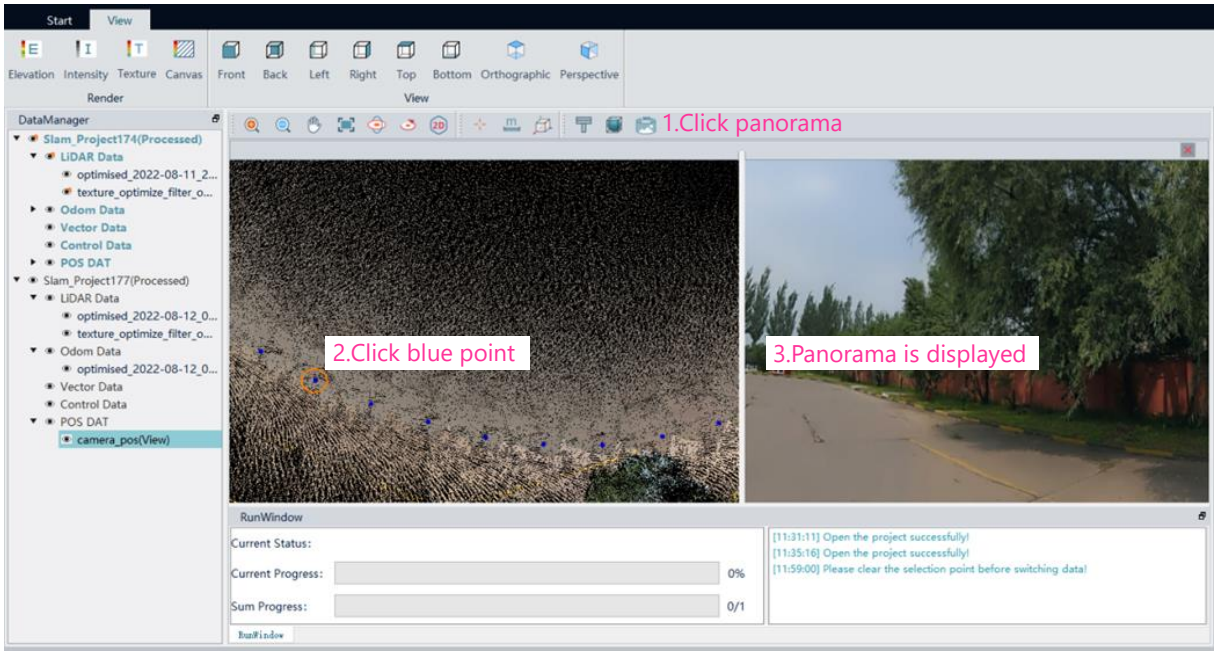


2.12 Panorama browsing

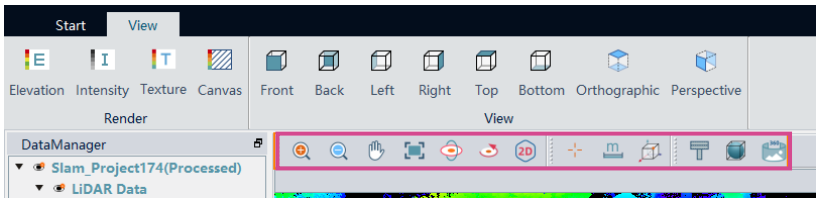
Select the cam_pos and right-click - Add to Viewer. The point in blue is the odometer trajectory. If you elaborate the panoramic images after the orientation, you can also view the images on the oriented point cloud by loading cam_pos_ori file.



Hold down the left button and move the mouse to browse the panorama.

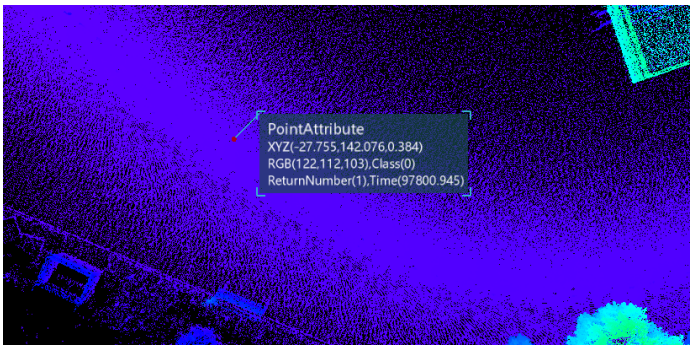


2.13 Tool bar

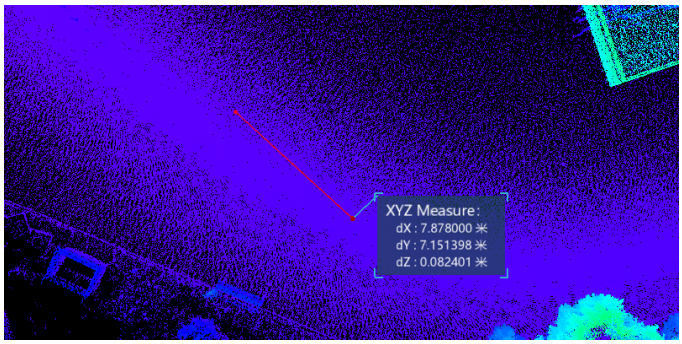


Here are meaning of tools:

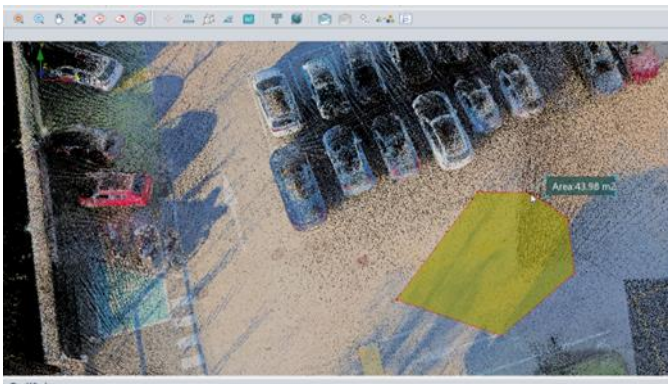
- Zoom in: Zoom in on the point cloud
- Zoom out: Zoom out on the point cloud
- Pan: Pan the point cloud
- Extent: Zoom to layer
- Rotation: rotate point cloud
- Rotation centre: change rotation centre for easy browsing
- 2D: Lock the plan view
- Pick point: pick single point to show its information



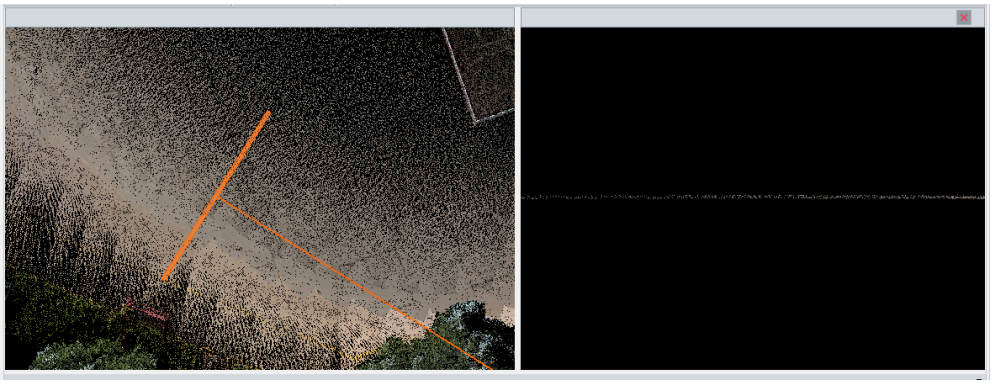
- Measure distance: measure 3D distance between two points
- Measure XYZ: measure distance between two points in XYZ Axis.



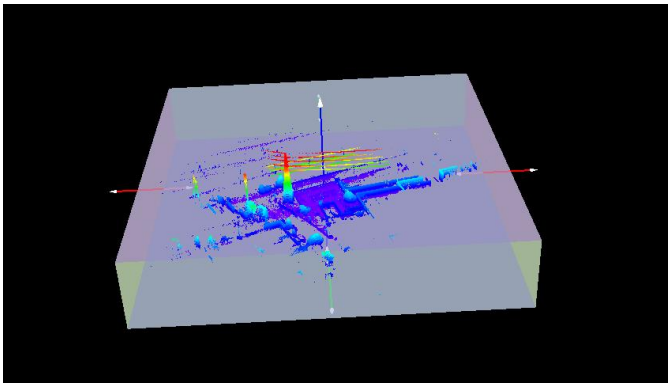
- Angle: Measures the inclination between two points.
- Area: Measure the area inside a polygon. Select polygon points by clicking on the points in the cloud. Double-click to close the polygon.



- Profile: Show point cloud details in a cross-sectional view



- Plan cut: Show point cloud details by change box boundary. To move box sides, press the control button and left click on one of the arrows. You will be able to move it.



- Panorama: refer to previous chapter
- Point Size: change the size of point in the point cloud visualization.
- Video: You can see the video recorded with X70GO.

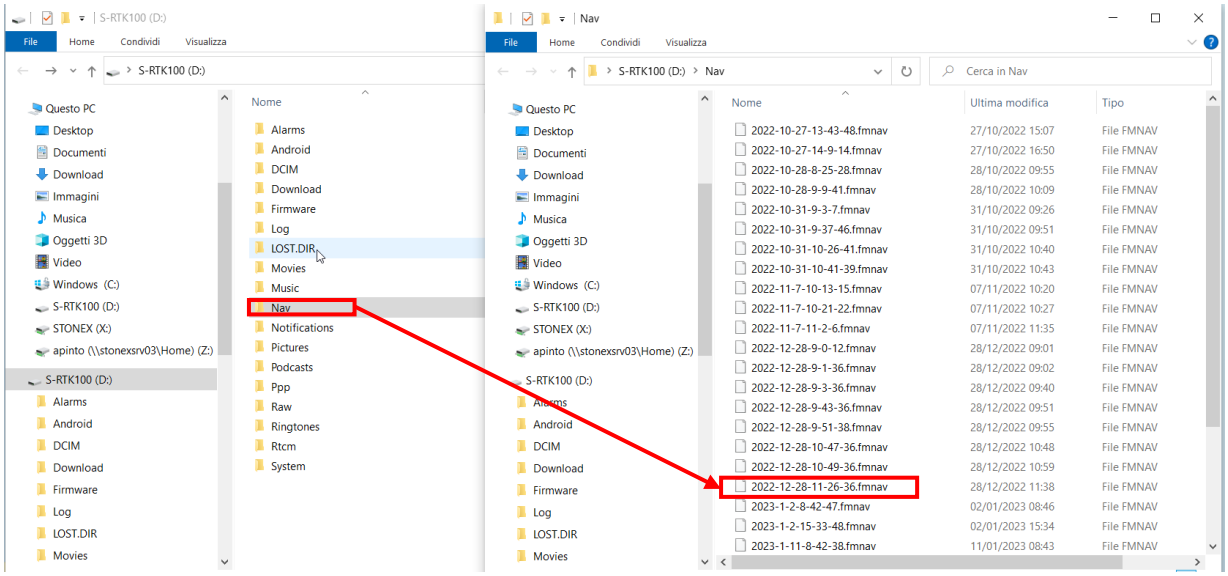
3. Process with RTK120^{GO} data

3.1 RTK processing

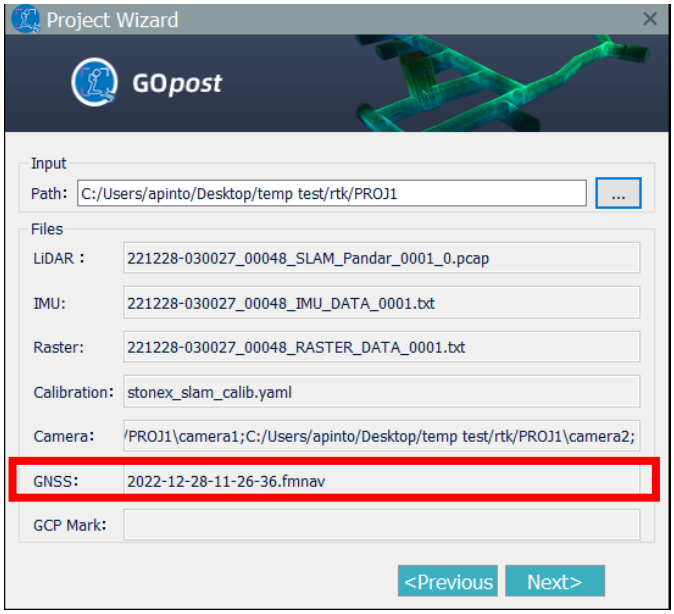
After the acquisition, insert you SD card of the RTK device in your PC to download the data relative to your project. In the memory of the SD card, select the Nav folder, then search for a file with the extension *.fmnav. This file contains the RTK information of the scan. The files are named with the following format:

YEAR-MONTH-DAY-HOUR-MINUTE-SECOND

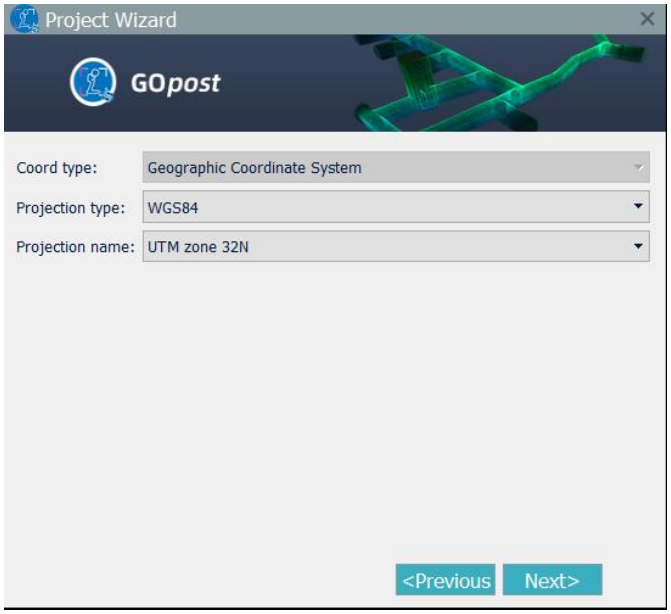
Select the corresponding file with the same date of the scan you want to process. Copy this file in the project folder of your scan. For example, will be selected the file of the 28 December 2022, at time 11.26.



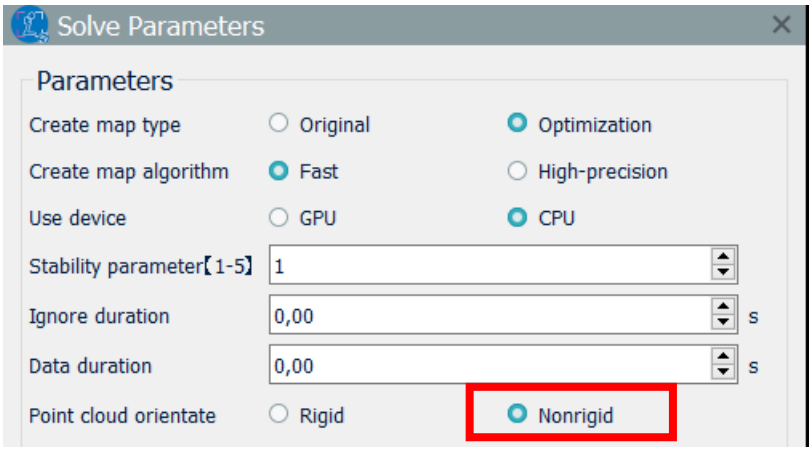
Open GO*post* and click New to create a new project. Choose the name and the save path, then choose the input path. Please check that in the GNSS section in the input screen there is the *.fmnav file.



Click *Next*, the software will ask the type of coordinates and the reference system. It should recognize it automatically. If the informations are correct, click *Next*.



Now you can process as for the other case the data, with the One-Click-Solve or with the Step-By-Step procedure. To better use the RTK information, in the orientation phase is preferrable to use the non-rigid body method.



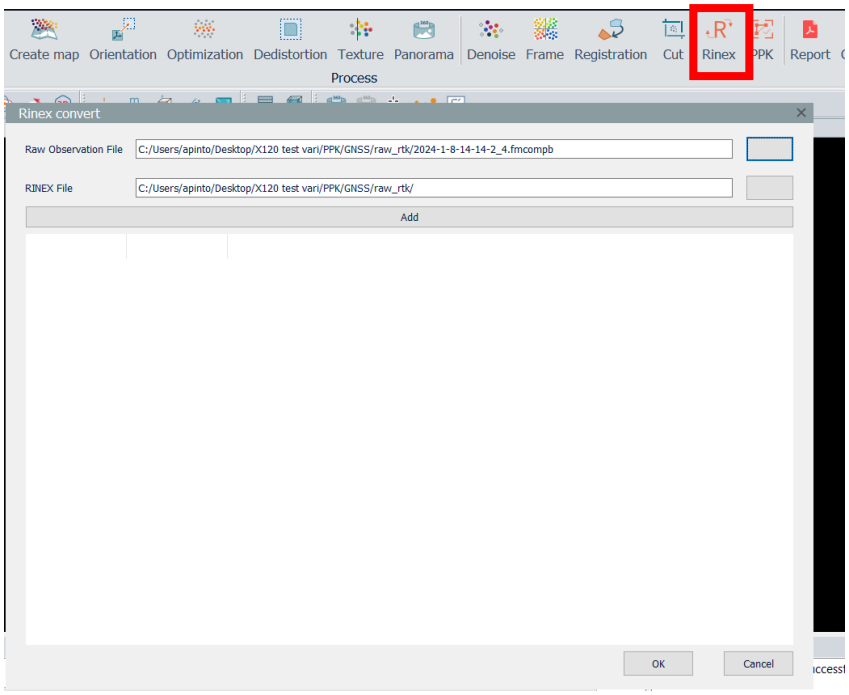
After the processing, the point cloud in the GCP subfolder of the project and all the subsequent point clouds, like the textured one, will be orientate in the reference system of the RTK data.

3.2 PPK post processing

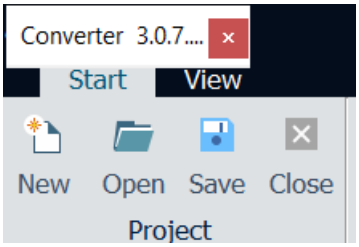
GOpost can let you post process RTK data, in order to perform orientation also when you can't get corrections from a base. This procedure should be done before the data processing and you need to have base data saved in rinex format.

First you need to transform raw data in Rinex format. Copy in a local folder the ".fmcompb" file from the SD card of the RTK.

Open GOpost and click on Rinex button. In this window in the "Raw observation file" you need to select the path to the .fmcompb file. In the "Rinex file" you insert the path where to save the rinex data.

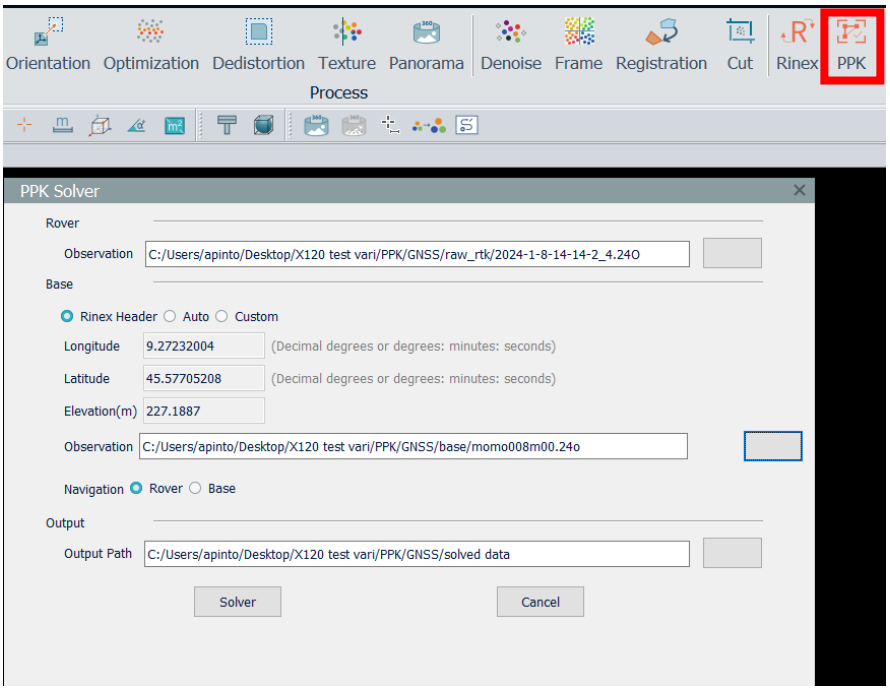


Click Ok. On the upper corner should open a window. If it does not close automatically after few seconds, click the x button and close t. Now the software will save the rinex data.



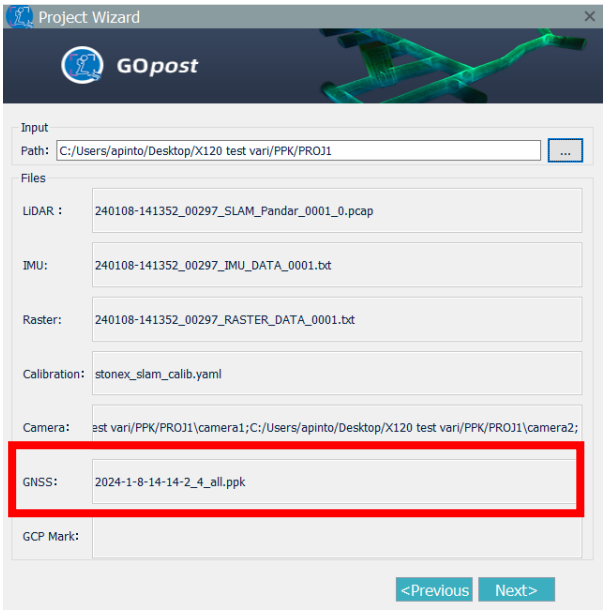
Now click PPK button, The PPK solver window will open. Load in rover observation the file with .O format coming from the RTK processed data.

In base observation load the .O format file from your base. Select the output path and click solver and wait the end of the processing.



In the output path you will find a file with the extension .ppk. This file is the one that will be used to perform non rigid orientation. Copy this .ppk file in the folder with the scanner data.

Create a new project, select as platform extension pole, and load the data of your project. In the GNSS row check that the .ppk file has been loaded.



After the successful import, process the data normally.

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