

STONEX® GOpost SLAM Processing Software **User Guide**



www.stonex.it

GOpost v58

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Changelog

GOpost	
	X70GO processing integration.
	• Possibility to post-process GNSS data and
Version 59	use them in Orientation step.
version 58	• 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.
	• Fixed bug related to fast algorithm.
Marrian F7	Added colorbars for elevation view.
version 57	Improved colorization algorithm.
	 Added refine_pos in colorization tool.
	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
Version 56	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.
	• Fixed a bug in Japanese systems that caused
Version 55	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. All other trademarks are the property of their respective owners.

2. GOpost 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: GOpost
- **2.** Follow the installation procedure.

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

GO post		Q	<i>∭</i> ≡ ×
Application Maintain	GOpost		
5325	⊕update 介download ট unload		versions: 59 🛈

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.

ሺ Proj	ect Wizard	×
(😰 GO <i>post</i>	
Name:	Slam_Project	
Date:	02/02/2024	
Device:	X120GO -	
Platform:	Hand	
Path:	Hand Creation Control	
Describe:		
	Next>	

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.

R Proj	iect Wizard	×
	😰 GO <i>pos</i> t	
Name:	Slam_Project	
Date:	02/02/2024	
Device:	x70G0 -	•
Platform:	Hand	•
Path:	Hand Backpack Extension pole Static Hybrid processing	-
Describe:	Next	

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.

ሺ Project	Wizard
Ø	GOpost
Input Path: C:/Us	sers/apinto/Desktop/X120 test vari/GCP orientation
Files	
LIDAR :	221123-134436_00036_SLAM_Pandar_0001_0.pcap
IMU:	221123-134436_00036_IMU_DATA_0001.bd
Raster:	221123-134436_00036_RASTER_DATA_0001.bt
Calibration:	stonex_slam_calib.yaml
Camera:	CP orientation\camera1;C:/Users/apinto/Desktop/X120 test vari/GCP orientation\camera2;
GNSS:	
GCP Mark:	
	<previous next=""></previous>

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.



Import Control Point × Coord type: Projected Coordinate System • Datum name: WGS 84 • Projection name: UTM zone 29N • Control Points • • Name X Y Z 1 1 514230.5510 5045440.1110 201.2950 2 2 514214.1330 5045463.6320 201.3040 4 4 514232.4580 5045463.6320 201.3040 4 4 514241.4910 5045443.1610 201.3720

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.

ID	East	North	Elev.
1,5	734.077,4	7421.254,	-4.780
2,5	755.409,4	7475.504,	-4.784
3,5	709.594,4	7488.166,	-4.762
4,5	654.184,4	7487.023,	-4.813
5,5	649.938,4	7439.035,	-4.774
6,5	694.595,4	7429.466,	-4.774

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.



ቢ Solve Parameters			×
Parameters			
Create map type	Original	Optimization	
Create map algorithm	○ Fast	High-precision	
Use device	O GPU	O CPU	
Stability parameter [1-5]	5		-
Ignore duration	0,00		♦ S
Data duration	0,00		▲ S
Point cloud orientate	○ Rigid	Nonrigid	
Other results	Panorama	Color point cloud	0
Other settings	□ Same start and end	Real-time display	
	Move object filter		
		ОК	Cancel

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: <u>do not tick the option</u> "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.

Nar	ne: 1	Order: 1	K: 514230.55	51 Y: 50454	40.111 Z: 2	01.295	x: 28.456	y: 4.595	z: -1.123	
Ref	Reference control point Matching control point									
							$+_{2}$ $+_{4}$ $+_{3}$ + ₁			
	Name	Order	Check	х	Y	z	x	У	z	
1	L	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	3		514232.458	5045463.632	201.304	6.518	0.273	-1.075	
4 4	1	4		514241.491	5045443.161	201.372	5.941	11.626	-1.126	
		ALIO	GN		OK		CAI	NCEL		

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.

POS attribute								;
Coordinate: Z Lo	cal Coordinate	Projected	Coordinate	Type WGS84 L	JTM ×	Coordinate UT	M zone 1N	~
Name: 3	Ord r 3	537654 184	Y: 432748	7 023 7: 4	813 x:	-8 177 v	61.018	7: -1.368
Reference control	point	5576541104		Matching	g control point		<u>enere</u>	
Name 1 1	order	→ → → - - - - - - - - - - - - -	x 537734.077 53775.409	Y 4327421.254 4327475 504	2 -4.78 -4.78	+ + + 5	+2 +- -0.889 56.437	z -1.389 -1.374
2 2	2		537755.409	4327475.504	-4./84	-8 177	61.018	-1.374
4 4	4		537694.595	4327437.025	-4.015	-62.812	50.263	-1.451
5	5					-12.921	0.365	-1.369
-	-					12.02.1		
ALIGN OK CANCEL								
<u></u>				ON		C/		
🤣 POS attribute	info					C,4	INCEL	;
9 POS attribute Coordinate: 🛛 Lo	info ocal Coordinate	Projected (Coordinate	Type WGS84 L	JTM 👻	Coordinate UT	M zone 1N	;
 POS attribute Coordinate: Lo Name: 3 Reference control 	info ocal Coordinate Order: 4)	 Projected (537654.184 	Coordinate Y: 432748	Type WGS84 L 37.023 Z: -4. Matching	JTM × 813 ×: g control point	Coordinate UT -62.812 yr	M zone 1N : 50.263	z: [-1.451
POS attribute Coordinate: 2 LC Name: 3 Reference control	info cal Coordinate] Ord r 4 ; point	□ Projected (537654.184	Coordinate Y: 432748	Type WGS84 L 17.023 Z: -4. Matching	JTM 813 xc g control point	Coordinate UT -62.812 yr +4 +3 +5	M zone 1N : 50.263 +2 +1] z: [-1.451
POS attribute Coordinate: 2 Lo Name: 3 Reference control	info cal Coordinate) Ord r 4) point	Projected 0 537654.184	Coordinate Y: 432748	Type WGS84 L 17.023 Z: -4. Matching	JTM 813 x g control point	Coordinate UT -62.812 yr + + + + + + + + + + + + + + + + + + +	M zone 1N : 50.263 +2 +1 y	z: -1.451
POS attribute Coordinate: Coordinate: Reference control Name 1 1 1 2	info cal Coordinate) Ord r. 4) point	Projected (537654.184	Coordinate Y: 432748 Y: 432748 S37734.077	Type WGS84 L 37.023 Z: -4. Matching V 4327421.254	JTM × 813 xc g control point z -4.78	Coordinate UT -62.812 yr + + + + 5 27.424	M zone 1N 50.263 +2 +1 -0.889	z: -1.451
POS attribute Coordinate: Coo	info cal Coordinate) Ord r 4 ? point	Projected (537654.184	Coordinate Y: 432748 Y: 537734.077 537755.409	Type WGS84 L 17.023 Z: -4. Matching V 4327421.254 4327475.504	JTM ▼ 813 xc g control point xc g control point xc xc yc xc xc xc yc xc yc xc yc yc xc yc yc yc yc yc yc yc yc yc y	Coordinate UT -62.812 yr +3 +5 x 27.424 39.193	M zone 1N 50.263 +2 +1 0.889 56.437 60.262	z -1.389 -1.374
POS attribute Coordinate: 2 2 1 Name: 3 3 3 Name: 1 1 2 2 3 3 4 4	info ccal Coordinate] Ord r 4 ; point	Projected (537654.184	Coordinate Y: 432748 Y: 532748 X 537734.077 537755.409 537654.184 532694 695	Type WGS84 L 17.023 Z: -4. Matching V 4327421.254 4327421.254 4327475.504 4327429.466	лтм 813 xc g control point xc g control point xc xc xc xc xc xc xc xc xc xc	Coordinate UT -62.812 yr +3 +5 x 27.424 39.193 -62.812 -12.921	M zone 1N 50.263	z -1.451 -1.389 -1.374 -1.369
POS attribute Coordinate: I Lo Name: 3 Reference control Name: 1 1 2 3 4 5	info ccal Coordinate] point	Projected (537654.184	Coordinate Y: 432748 Y: 537734.077 537755.409 537654.184 537694.595	Type WGS84 L 17.023 Z: -4. Matching V 4327421.254 4327429.466	лтм × 813 xc g control point xc g control point xc xc xc xc xc xc xc xc xc xc	Coordinate UT -62.812 yr +4 +5 x 27.424 39.193 -62.812 -12.921 -8.177	M zone 1N 50.263	z -1.451 -1.451 -1.389 -1.374 -1.369 -1.368
POS attribute Coordinate: I Lo Name: 3 Reference control I 1 2 2 3 3 4 4	info ccal Coordinate point r 4) point	Projected (537654.184	Coordinate Y: 432748 Y: 532748 X 537734.077 537755.409 537654.184 537694.595	Type WGS84 L 37.023 Z: -4. Matching Matching V 4.327421.254 4327421.254 4327475.504 4327429.466 4.327429.466	лтм × 813 xc g control point xc g control point xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc xc yc yc yc yc yc yc yc yc yc y	Coordinate UT -62.812 yr +3 +3 +5 27.424 39.193 -62.812 -12.921	M zone 1N 50.263	z: -1.451

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.

🧐 POS attribute	info								×
Coordinate: 🗹 Lo	cal Coordinate	Projected	Coordinate	Type WGS84	UTM ×	Coordinate L	JTM zone 1N		Ŧ
Name:	Order:	X:	Y:	Z:	×		y:	z	
Reference control	point			Matchi	ng control point				
[- , 	ф-ф- ∳-ф- ndant							
Name	Order	Check	×	Y	z	×	у	z	ľ
11	1		537734.077	4327421.254	-4.78	27.424	-0.888	-1.388	- 1
2 2	2		537755.409	4327475.504	-4.784	39.192	56.438	-1.369	
3 3	3		537709.594	4327488.166	-4.762	-8.178	61.017	-1.364	
4 4	4		537654.184	4327487.023	-4.813	-62.812	50.26	-1.446	
5 5	5		537694.595	4327429.466	-4.774	-12.917	0.363	-1.367	
6 6			537600.595	4327300.466	-4.772				
	ALIO	GN		OK		C/	ANCEL		

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.

GOp	ost										
	Start	View									
1			×			2		***		-	
New	Open	Save	Close	One-click solve	Batch solve	Create map	Orientation	Optimization	Dedistortion	Texture	Panorama
	Pro	ject								Process	

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.

Start View * × Þ Open Save Close One-click Slov New Project DataManager Ð ٢ Slam_Project3456(Processed) LiDAR Data optimised_2022-08-19_1... 👁 textur Odom Dat Add to viewer Vector Dat Remove from viewer Control Da POS DAT Zoome to layer Show/Hide Data export 🗁 Open path Attributes

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.

GOpost								
Start View								
11 📠 🖬 🛛		\supset		E C				Ľ
New Open Save Close	One-click solve	Batch solve	Create map	Orientation	Optimization	Dedistortior	n Texture	Pano
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DataManager	₽ 🧕 🤍	🕛 🗔 🍕	3 20	- <u>+</u> <u>m</u>	🗇 🕢 🔜	₸ 🧊		+
 Slam_Project(UnProject) LiDAR Data 	o Solve	Parameters			i	· · · · · · · · · · · · · · · · · · ·		×
Odom Data	Paramet	ers						
Vector Data	Create map	algorithm	O Fast		🗿 High	-precision		
Control Data Doc Data	Use device		O GPU		O CPU			
• POS Data	Stability par	ameter [1-5]	5					
	Ignore dura	tion	0,00				s	
	Data duratio	on	0,00				s	
	Other settin	gs	Same	start and end	🗹 Real	-time display		
			Move	object filter				
						OK	Cancel	

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.

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.

GOpo	ost										
S	tart	View									
1			×	3		200	E .	***		:	100
New	Open	Save	Close	One-click solve	Batch solve	Create map	Orientation	Optimization	Dedistortion	Texture	Panorama
	Proj	ect								Process	

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.

			-		-		
×***		-	100		<u>848</u> 848	2	8
Optimization	Dedistortion	Texture I	Panorama	Denoise	Frame	Registrat	ion Cut
		Process					
🜌 🔜	₸ 🗊 🛛	🗒 👘 🕇		5			
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Select			File	0 00 00 00 00	27		
		optimised	_2024-02-0	9_09-26-23_3	327		
	ор	timize_optin	nised_2024-	02-09_09-26	-23_327		
Paramet	ters						
Neighbo	orhood Points	: 10 🗘	Standard o	leviation m	ultiple:	80 🗘	
				Ok		Cancel	

- 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.

timization C	Real Arientation Dec	distortio Process	n Ti	exture Pano	orama Dnos	ize Frame	Regist	rater	Cut	Cance
10	四 四	T		12						
Data fra	the:						×			
Data							-			
Select				File						
2	f	ilter_opt	imise	d_2022-08-23	21-22-35_80	2				
		optimi	sed_i	2022-08-23_2	1-22-35_802					
8	optim	ize_filter	opti	mised_2022-0	08-23_21-22-3	5_802				
	texture_o	ptimize_	fiter_	optimised_20	22-08-23_21-2	22-35_802				
Frame mod	Scale		•	Prefix: [
Scale:	2/3D (1:2000?	}					*			
Size:	50*40 • c		cm	Expansion:	0.00		m			
Start X	-0.1	0	km	Start Y:	-0.1	0	km			
					OK	Cance				

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*.

	tart	view													
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New	Open	Save	Close	One-click solve	Batch solve	Create map	Orientation	Optimization	Dedistortion	Texture	Panorama	Denoise	Frame	e Registration	Cut
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• 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*.

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-46.960	-84.653		5.864	0.000	Î
-46.798	-84.689		7.714	0.000	â
-32.175	-80.097		5.894	0.000	
-32.291	-80.261		7.734	0.000	
on data: tex	ture_optimize_filt	er_optimis	ed_2022-08-12_	09-51-52_958	-
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-26.831	209.871		8.378	0.016	ŝ
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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.

Dptimization Orientation Dec	distortion Texture	Panorama Dnosize	Frame Reg	jistrater
ي 🗠 + 📾 🔊	T 🗊 🖻			
Data cut			×	
Select		File		
	optimised_2022	2-08-24_20-42-23_893	-	
Output method:	O File first	○ Range frist		
Cut range:	114-1;			
Cut expansion:	10.00		m	
		Cut	Cancel	

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	2022/8/24 20:55
denoise	2022/8/24 20:55
dimages	2022/8/24 20:55
filter	2022/8/24 20:55
gcp	2022/8/24 20:55
odometer	2022/8/24 20:55
optimizer	2022/8/24 20:55
pano	2022/8/24 20:55
pos	2022/8/24 20:55
register	2022/8/24 20:55
subdiv	2022/8/24 20:55
temp	2022/8/24 21:19
texture	2022/8/24 20:55
Slam_Project562.sprj	2022/8/24 21:20

- 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.

GOpost	÷														
Star	t View														
E	I	Т		ED	\$										
Elevation	Intensity	Texture	X-ray	EDL	Travel	Canvas	Front	Back	Left	Right	Тор	Bottom	Orthographic	Perspective	
		Ren	nder								١	/iew			
DataMar	nager		8	0	Q 🕛) 🔁	3	2D	-¦m		<u>/a</u>			👌 🗄 🛻	s

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
- Den: 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.
- Sideo: 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.

🕵 Project \	Wizard ×
	GOpost
Input	
Path: C:/Us	ers/apinto/Desktop/temp test/rtk/PROJ1
Files	
LiDAR:	221228-030027_00048_SLAM_Pandar_0001_0.pcap
IMU:	221228-030027_00048_IMU_DATA_0001.bt
Raster:	221228-030027_00048_RASTER_DATA_0001.txt
Calibration:	stonex_slam_calib.yaml
Camera:	/PROJ1\camera1;C:/Users/apinto/Desktop/temp test/rtk/PROJ1\camera2;
GNSS:	2022-12-28-11-26-36.fmnav
GCP Mark:	
	<previous next=""></previous>

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*.

🕵 Project Wi	zard X
ە 🕥	GO <i>post</i>
Coord type:	Geographic Coordinate System
Projection type:	WGS84 👻
Projection name:	UTM zone 32N 👻
	<previous next=""></previous>

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.

(🕵 Solve Parameters							
	Parameters							
	Create map type	Original	Optimization					
	Create map algorithm	O Fast	\bigcirc High-precision					
	Use device	O GPU	O CPU					
	Stability parameter [1-5]	1		-				
	Ignore duration	0,00		•	s			
	Data duration	0,00		-	s			
	Point cloud orientate	○ Rigid	Nonrigid					

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.

**	E	9	8 88		:**		*	888	5		₹R₹	R	A
Create map	Orienta	ation	Optimization	Dedistortion	Texture	Panorama	Denoise	Frame	Registration	Cut	Rinex	РРК	Report (
					Process					-		-	
Rinex conv	ert												×
Raw Observa	tion File	C:/Us	sers/apinto/Deskto	p/X120 test vari/PI	%/GNSS/rav	v_rtk/2024-1-8-	14-14-2_4.fn	ncompb					
RINEX File		C:/Us	ers/apinto/Deskto	p/X120 test vari/Pi	K/GNSS/rav	v_rtk/							
						Add							
										ок		Cancel	rcess
													iccessi

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.

Orientation Optin	nization Dedistortion	Texture Process	Panorama	Denoise	Frame	Registration	Cut	• R [→] Rinex	<mark>Ж</mark> РРК
+ 🕮 🍺 🖌	🛚 🔜 🗏 🖵 🧊 🗌	**	t_ ⊷ . ⊆]					
	2								
PPK Solver								\times	
Rover									
Observation	C:/Users/apinto/Desktop/>	(120 test vari/	PPK/GNSS/raw	_rtk/2024-1-8	-14-14-2_4	1.240			
Base									
Rinex Head	der 🔿 Auto 🔿 Custom								
Longitude	9.27232004 (Dec	mal degrees o	or degrees: min	utes: seconds	5)				
Latitude	45.57705208 (Dec	mal degrees o	or degrees: min	utes: seconds	5)				
Elevation(m)	227.1887								
Observation	C:/Users/apinto/Desktop/X	.20 test vari/P	PK/GNSS/base/	momo008m0	0.240				
Navigation	Rover 🔿 Base								
Output									
Output Path	C:/Users/apinto/Desktop/>	120 test vari/	PPK/GNSS/solve	ed data					
	Solver			Cano	cel				

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.

🕵 Project	Wizard
Ø	GOpost
Input	
Path: C:/Us	ers/apinto/Desktop/X120 test vari/PPK/PROJ1
Files	
LIDAR:	240108-141352_00297_SLAM_Pandar_0001_0.pcap
IMU:	240108-141352_00297_IMU_DATA_0001.txt
Raster:	240108-141352_00297_RASTER_DATA_0001.bt
Calibration:	stonex_slam_calib.yaml
Camera:	est vari/PFK/PR0J1\camera1;C:/Users/apinto/Desktop/X120 test vari/PFK/PR0J1\camera2;
GNSS:	2024-1-8-14-14-2_4_all.ppk
GCP Mark:	
	<previous next=""></previous>

After the successful import, process the data normally.

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