

# **CHCNAV CoPre SW**

**User Manual** 



Mobile Mapping | November 2023

Make your work more efficient



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## Introduction

CoPre 2 is a CHCNAV self-designed LiDAR raw data pre-processing software. It supports multiple useful functions: POS process by self-designed algorithm; One-button processing, simple and efficient; Point cloud process, picture collate, depth map, data colorize all available; Adjust & refine functions which can improve post-processing accuracy; Mass point cloud data viewing etc.

Main functions of CoPre 2 software:

- POS processing: Supports POS file processing. Both points select, box select, polygon select, and time select are available.
- Auto-processing: One-button process point cloud data, picture collation, point cloud colorize, depth map and results output.
- Adjust: Solve the layering problem of multiple point clouds, improve data accuracy.
- Refine: Based on control point characteristics, supports elevation, horizontal, 3D refines, and time/distance refine functions, improve data accuracy.
- Result export: Output adjusted/ refined result data, include point cloud, pictures, colorized point cloud and depth map.
- Point cloud view: Support mass of data viewing, rendering, slice, and control point select option.

## 1 Installation

This chapter describes the requirements on the operating system, hardware devices, installation, and uninstallation of CoPre software, and precautions.

Operating system	Microsoft Windows7 (64bit) Microsoft Windows10 (64bit)
CPU	Minimum: 2+ GHz
	Recommend: 3.5+ GHz
Memory	Minimum: 16GB
	Recommend: 64GB
GPU	Only NVIDIA is supported, GTX1050ti and above
	Graphics card driver after 2021
Display resolution	1920*1080 above
.NET environment	.NET Framework 4.0

## 1.1 PC Hardware Requirement

## 1.2 Software Installation

### Notes

Turn off 3<sup>rd</sup> party antivirus software in case the install process being interrupted. And the install path needs complete English letters.

• Open software package then confirm "I agree" on license terms and continue installation:



Waiting software install completely:





When software installed successfully, click finish to close current interface.



## **1.3 Software Uninstall**

First way, click "Start" to open windows start menu. Find CoPre 2 folder then click "Uninstall CoPre2" and click yes to start uninstalling.



Second way, go to "Settings – Apps", and find CoPre 2 then right click to uninstall.

## 2 Data Structure

This chapter introduces the engineering structure and data storage method used in CoPre software solution.

## 2.1 Project Structure

A complete CoPre 2 project structure contains 4 folders: GPS, IMG, SCAN and TRACE.

Name	Date modified	Туре	Size
GPS	11/15/2021 10:15 PM	File folder	
IMG	11/15/2021 10:15 PM	File folder	
SCAN	11/15/2021 10:17 PM	File folder	
TRACE	3/23/2021 1:48 PM	File folder	

## 2.1.1 GPS

> AA450 raw data > @@2021-02-25-061938 > GPS	<b>১ √ ঊ</b> ়∕	Search GPS
Name	Date modified	Туре
📜 Base	3/24/2021 1:56 PM	File folder
📙 Ctrl	2/25/2021 3:46 PM	File folder
🦲 Post	5/28/2021 10:55 AM	File folder
📙 Rover	3/24/2021 1:57 PM	File folder
📙 Rtk	2/25/2021 3:46 PM	File folder
Sync	2/25/2021 3:46 PM	File folder

- Base: Need copy receiver static data inside. Support HCN and RINEX 3.02 formats.
- **Ctrl**: Storage control point file. Empty by default.
- Post: Storage POST file. Empty by default, and after POS process finished, user can find .post file inside.
- **Rover**: Storage LiDAR GNSS data and IMU data.
- **RTK**: Storage RTK data under none-base mode. Empty by default.
- **Sync**: Storage camera trigger data. Empty by default.

### 2.1.2 IMG

This folder stores AA450 picture data. And CP is the configuration files of this set of camera data.

@@2021-03-22-084031 > IMG > Camera1 ~				
^	Name	Date		
	🤍 @@2021-03-22-08403	3/26/2021 2:51 PM		
	📄 0000000000000001.J	1/1/2014 12:06 AM		
	📄 00000000000000002.J	1/1/2014 12:07 AM		
	📄 0000000000000003.J	1/1/2014 12:07 AM		
	📄 0000000000000004.J	1/1/2014 12:07 AM		
	📄 0000000000000005.J	1/1/2014 12:07 AM		
	📄 00000000000000000.J	1/1/2014 12:07 AM		
	📄 0000000000000007.J	1/1/2014 12:07 AM		
	📄 0000000000000008.J	1/1/2014 12:07 AM		
	📄 0000000000000000.J	1/1/2014 12:07 AM		
	📄 0000000000000010.J	1/1/2014 12:07 AM		
	📄 0000000000000011.J	1/1/2014 12:07 AM		
	📄 0000000000000012.J	1/1/2014 12:07 AM		
	📄 000000000000013.J	1/1/2014 12:07 AM		
	📄 0000000000000014.J	1/1/2014 12:07 AM		
	1 000000000000000000000000000000000000	1/1/2014 12:07 AM		
	📄 0000000000000016.J	1/1/2014 12:07 AM		
	1 000000000000000000000000000000000000	1/1/2014 12:07 AM		

### 2.1.3 SCAN

This folder stores raw laser data of LiDAR. And EP is the configuration files of this set of laser data, which contains the lever arm information of antenna. Different drone will use different. EP file as the antenna location is different.

@@2	2021-03-22-084031 > SCAN > Scanner1	~	Ū		Q
^	Name		modif	ied	Туре
	084031_L.pcap	3/23/	2021	1:51 PM	PCAP File
	I300-2.0.EP	4/16/	2021	2:28 PM	EP File

## **2.1.4 TRACE**

Storage test log data and normally is empty.

## 2.2 Task Structure

A complete CoPre 2 task contains Reconstruction folder, Results folder, SolveProjects folder, coc file, cpr file, crd file and db file.

- Reconstruction file is the temporary data folder generated during reconstruction.
- Results file is the final output result folder, including point cloud, orthophoto, model and other result files.
- .coc file contains the project coordinate system information.
- .cpr file is the task project file.
- db file contains the GCP information of ground control points.
- .crd file is the coordinate system file that produces the result.

D:) > CopreWorkSpace > test1			~ Ū
名称 ^	修改日期	类型	大小
Reconstruction	2023/3/20 11:05	文件夹	
📕 Results	2023/3/20 11:05	文件夹	
💐 test1.cpr	2023/3/20 18:30	CPR 文件	3 KB
🗟 test1.db	2023/3/20 10:58	Data Base File	84 KB
test1_NEH.crd	2023/3/20 10:48	CRD 文件	4 KB
🗋 test1Default.coc	2023/3/20 10:48	COC 文件	1 KB

## 2.2.1 Reconstruction Folder

Reconstruction folder is the temporary data folder, contains AT\_Temp, DOM\_Temp and Model\_Temp.

吉 > 网络 > 10.1	] > 网络 → 10.12.11.81 > g > 2-CoPre-Project > 450-m > Reconstruction				
名称	^	修改日期	类型	大小	
📒 AT_Temp		2022/8/23 11:41	文件夹		
DOM_Tem	р	2022/8/23 17:08	文件夹		
📒 Model_Ten	np	2022/8/24 9:49	文件夹		

## 2.2.2 Results Folder

Results folder contains final output information after generate result in CoPre 2. Depends on different processing modes, it might have 4 type folders: auto-solve result, adjust result, refine adjust and adjust & refine together result.

ADJUST1	2020/11/14 9:27	文件夹
ADJUST1_REFINE1	2020/11/16 11:42	文件夹
AUTOSOLVE	2020/11/13 11:11	文件夹
REFINE1	2020/11/12 15:46	文件夹

 AUTOSOLVE: For a complete auto-solve workflow, it should contain camera and scanner folders with auto processed result files (picture, depth map, point cloud data).

AA450 raw data > Screen > Results > @@2021-03-22-084031 > AUTOSOLVE V O Search AU... P

^	Name	Date modified	Туре	Size	
	📜 Camera1	28/05/2021 18:27	File folder		
	📕 Scanner1	28/05/2021 18:28	File folder		
	@@2021-03-22-084031.result	28/05/2021 18:28	<b>RESULT File</b>	5 KB	
	CloudPoint.coc	28/05/2021 15:45	COC File	1 KB	
	Picture.coc	28/05/2021 15:45	COC File	1 KB	

- ADJUST: For a complete adjust workflow, it should contain camera and scanner folders with adjusted result files (picture, depth map, point cloud data).
- REFINE: For a complete refine workflow, it should contain camera and scanner folders with refined result files (picture, depth map, point cloud data).
- ADJUST\_REFINE: For a complete adjust & refine workflow, it should contain camera and scanner folders with adjust & refined result files (picture, depth map, point cloud data).

### 2.2.3 SolveProjects Folder

SolvedProjects folder contains intermediate output information after preprocess in CoPre 2. Depends on different processing modes, it might have 4 type folders: GPS, REFINE, ADJUST, SOLVED.

- GPS: For a complete preprocess workflow, it should contain base and rover folder with relative GNSS & IMU files.
- SOLVED: For a complete preprocess workflow, it should contain preprocess files with .codata format.
- ADJUST: For an adjust preprocess workflow, it should contain new adjust POST file with .codata format.
- REFINE: For a refine preprocess workflow, it should contain new refine POST file with .codata format.

## 3 Main Interface

This part includes task management, project management and window, as shown in the following figure.

Home	Proce	essing	Reconstr	ruction	Tools	Help								
¢	-	2		$\bigotimes$		K	Ŵ	<u>છ</u>		🗰 Default	🎭 Resources	Trajectory	<b>K</b>	7
Wizard	Create	Open	Recent	Close	Coordinate	Import	Remove	Configure	Info	🖸 3D View	E Output	🗄 GCP	Import	Export
		Wo	rkspace				Pr	oject			Window		Ve	ctor

## 3.1 Task & Project

Task & Project mainly include Task Wizard, Create Task, Open Task, History Task, Close Task, Coordinate, and related Settings of the calculation project.

## 3.1.1 Task Wizard

### Description

Create a new CoPre 2 task wizard to guide client process data.

### Steps

Click "Main – Task – Wizard" to start data import.



 On step 1, configure the task name, project data path, output data path, units, and task description (option). Then, click next.



👫 🛛 Task Wizard	i				×
1 —	2		- 4 -		- 6
Create Task	CS Settings	Task Type	POS Solve	Trajectory Display	Result Settings
Please select p	roject data.				
Task Name:	CHC_20220822163707				
Project Data:	G:\1-Data\L1-AA450\AA450	\@@2022-05-07-021757			
Task Path:	G:/2-CoPre-Project				
Units:	Meters				v
Task Descriptio	on:				
Please add task	related information				
Cancel					Next

• On step 2, Coordinate system setting, the user clicks the button on the right side of the coordinate system to set the coordinate system parameters.

😽 🛛 Task Wizard					×
1 —	- 2	- 3	- 4	- 5	- 6
Create Task	CS Settings	Task Type	POS Solve	Trajectory Display	Result Settings
Please set the target	coordinate system.				
Coordinate System:	WGS84 / Gaussian Projecti	on / 114.0E			
Cancel				Back	Next

• On step 3, select the data source and result type, the data source can choose laser and image, and the output can choose laser point cloud, orthophoto image and 3D model.

😽 🛛 Task Wizard						×
1 2	. —		4		6 —	6
Create Task CS Se	ttings	Task Type	POS Solve	Traje	ctory Display	Result Settings
Please select the data source an	nd output resu	lt type.				
Source Data		Output Results		Estimated Time	High Efficiency	High Quality
🕑 Lidar		Point Cloud				8.0min
		DOM				
🗹 Image		🕑 3D Model				1h19min
Tips: High efficiency: Quickly gener High quality: Generate high q	ate result, but	the effect of building & water are ut the processing time is longer.	a is relative ;	poor.		
Cancel					Ba	ck Next

 On step 4, configure the base settings to process POST file. Click "Next" to start process, and the POST file will be loaded automatically when finish.

😽 🛛 Task Wizard					×
1 2	) (	3 ———	4	5	6
Create Task CS Setti	ings Tas	k Type	POS Solve	Trajectory Display	Result Settings
Please set the base or download	the cloud base data;If	it exists, you can click	the next step.		
@@2022-05-07-021757	Base Station				
	Cloud Base	Add	Remove		
	Base1				
	Base Station Coor	rdinate		Antenna Settings	
	Base Name:	3387460127B.22o		Measured Height (m):	
	B:	30:27:23.325090	N	Measure To:	Ψ.
	Ŀ	114:28:41.885790	E v	Antenna Phase Height (m):	1.6489
	H (m):	23.1330		Manufacturer:	
	CS Type:	WGS84 BLH	Ŧ	Antenna Type:	
		Select	Save	Sampling Rate (s):	
					More
Cancel				ſ	Back Next

 On step 5, select target trajectories to process point cloud & picture data. Click "Next" to start process.



## CHCNAV

• On step 6, set the parameters related to the results, and then click "Finished".

😽 Task Wizard				×
1 2	3	4	- 5 -	6
Create Task CS Settings	Task Type	POS Solve	Trajectory Display	Result Settings
Please set the task parameters.				
Lidar				
Solve Settings				
Filter Settings Sampling Rat	te: 100% =			
Point Cloud Coloring				
Remove Unshaded Points				
Adjust				
Output Path D:/CopreWorkSpa	ce/CHC 20230412165029/Re	esults		
Cancel	20230412103023/18	suits		Back Finished
😽 🛛 Task Wizard				×
Task Wizard	3	4	5	×
Task Wizard	<u>3</u> Task Type	POS Solve		× 6 Result Settings
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Task Wizard	3 Task Type	POS Solve	Trajectory Display	× Result Settings
Task Wizard  Task Wizard  Create Task CS Settings  Please set the task parameters.  Lidar Model Scene Settings  City	Task Type	POS Solve	Trajectory Display	× 6 Result Settings
Task Wizard  Task Wizard  Create Task CS Settings  Please set the task parameters.  Lidar Model Scene Settings  City Model Settings	3 Task Type	POS Solve		K 6 Result Settings
Task Wizard      Task Wizard      Create Task CS Settings  Please set the task parameters.  Lidar Model Scene Settings  City Model Settings  Adaptive Tile's Size	3 Task Type	POS Solve		K G Result Settings
Task Wizard      Create Task CS Settings  Please set the task parameters.  Lidar Model Scene Settings  City Model Settings  Adaptive Tile's Size Custom Tile's S	3	POS Solve	Trajectory Display	K G Result Settings
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Custom Tile's Size         Custom Tile's Size (m)         ①         ④       Advanced Settings		POS Solve	5 Trajectory Display GB.	Contract of the second
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         © Adaptive Tile's Size         © Custom Tile's Size (m)       10		POS Solve	5 Trajectory Display GB.	Contraction of the second seco
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Custom Tile's Size         Custom Tile's Size (m)         ①         ① Advanced Settings         ② Output DOM         DOM Settings	3 Task Type	POS Solve	GB.	Contraction of the second seco
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Custom Tile's Size         Output DOM         DOM Settings         Adaptive Resolution         Output Resolution		POS Solve	GB.	Kesult Settings
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Adaptive Tile's Size         Custom Tile's Size (m)         ①         Adaptive Tile's Size (m)         ① Adaptive Tile's Size         Custom Tile's Size (m)         ①         Adaptive Resolutions         ○ Adaptive Resolution         ○ Custom Resolution (m)	.05	POS Solve	Trajectory Display	Kesult Settings
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Adaptive Tile's Size         Custom Tile's Size (m)         ①         ④ Advanced Settings         ⑤ Output DOM         DOM Settings         ④ Adaptive Resolution         ○ Custom Resolution (m)		Predicted memory usage:	GB.	Contraction of the second seco
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       v         Model Settings         Custom Tile's Size         Custom Tile's Size (m)         Output DOM         DOM Settings         Adaptive Resolution         Custom Resolution (m)		Predicted memory usage:	GB.	Contraction of the second seco
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         Custom Tile's Size         Custom Tile's Size (m)         DM Settings         Output DOM         DOM Settings         Adaptive Resolution         Custom Resolution (m)		Predicted memory usage:	GB.	Kesult Settings
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         © Adaptive Tile's Size         © Custom Tile's Size (m)         ①         ④ Advanced Settings         ② Output DOM         DOM Settings         ③ Adaptive Resolution         ○ Custom Resolution (m)	0.00 \$) Confirm	Predicted memory usage:	GB.	Result Settings
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Yease Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         © Adaptive Tile's Size         © Custom Tile's Size (m)         ①         ④ Advanced Settings         ② Output DOM         DOM Settings         ③ Adaptive Resolution         ○ Custom Resolution (m)	0.00 \$) Confirm	Predicted memory usage:	GB.	Result Settings
Task Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         © Adaptive Tile's Size         © Custom Tile's Size (m)         ①         ④ Advanced Settings         ③ Output DOM         DOM Settings         ③ Adaptive Resolution         ○ Custom Resolution (m)	0.00 ‡) Confirm	Predicted memory usage:	GB.	Contraction of the second seco
Yease Wizard         1       2         Create Task       CS Settings         Please set the task parameters.         Lidar       Model         Scene Settings         City       *         Model Settings         © Adaptive Tile's Size         © Custom Tile's Size (m)         @ Advanced Settings         © Output DOM         DOM Settings         © Adaptive Resolution         © Custom Resolution (m)         Qutput Path         Gy/2-CoPre-Project/CH	0.00	Predicted memory usage:	GB.	Kesult Settings

 CoPre 2 will load result automatically when finished. User can view data on software interface.

Home       Processing       Reconstruction       Tools       Help         Import Second       Import Second       Import Second       Import Second       Import Second         Witzard Create       Open Recent       Close       Coordinate       Import Remove Configure       Import Second         Resources       # ×       Trajectory       # ©        Import Second       # ×       CP         *       Frojects       #        ©        Import Second       Import GCP       A         *       ©        ©        Import Second       I	6 × I GCP Refine 1
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* Projects	Refine 1
▼ @@2022-05-07-021757 Query: Images 1% Name(ID) Type	Refine 1
Images 1% Name (ID) Type	Refine 1
Point Clouds 0%	
Processing	
Reconstruction	
- AT	
- DOM	
Model	
339/40107/78	
Output # x	
O Error 🔥 O Warning 0.2 Messages	
Message 2023-04-12 16:51:55 [@@2022-05-07-021757_Camera1] Start processing images, selected time areas: 5	
Message 2023-04-12 16:51:55 [@@2022-05-07-021757_Scanner1] Start processing lidar data, time areas: 5	
	>

### 3.1.2 Create Task

### Description

Create a CoPre 2 task. Each task can contain multiple projects.

### Steps

• Open "Main – Task – Create" to start data import.



#### Notes

- Both project data path and output data path not support non-English letters and space.
   Save the data under English path.
- There are two types of time base: GPS-1970 means time is start from 00:00:00 of January 1st, 1970; GPS-1980 means time is start from 00:00:00 of January 6th, 1980.
- Configure task name, project data path, output data path, units, and task description (option). Finally, click "Create".



👫 🛛 Create Task		×
Task Name:	Test_01	
Project Data:	E:\TEST\@@2022-03-03-025403	
Task Path:	E:\TEST\	
Units:	Meters	
Task Descriptio	n:	
Please add task	related information	
	Create	Cancel

• The CS settings window will display on interface, click "more" to set the CS settings.



### 3.1.3 Open Task

### Description

User can click "Main – Task – Open" or double click .cpr file to import an exist task.



#### Steps

- Click "Main Task Open" on toolbox and choose .cpr file to open an exist task.
- User can also double click .cpr file in folder to open task.

📙   🛃 📜 🚽   CHC_20211	116182352			_	$\Box$ ×
File Home Share	View				~ ?
← → • ↑ 🖡 « AA4	50 > AA450-DATA > CHC_20211116182352	~	U	Search CHC	_2021111 🔎
🥌 M3D (D:)	Name ~	Date	modifi	ed	Туре
AA450	Results	11/16	5/2021	6:24 PM	File folder
AA1400	SolvedProjects	12/28	3/2021	3:39 PM	File folder
AA2400	🐝 CHC_20211116182352.cpr	1/12/	2022 7	':31 PM	CPR File
📜 Alpha3D	SHC_20211116182352.db	11/16	5/2021	6:24 PM	Data Base File
📙 Alpha3D_Dual	CHC_20211116182352_NEH.crd	1/12/	2022 2	2:46 PM	CRD File
📜 AlphaUni	CHC_20211116182352Default.coc	11/16	5/2021	6:24 PM	COC File
AS200					
📕 AU200					
Backpack					
BB4					
📕 BB4mini					
CoPre2.0					
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B M3D_PICTURES ✔ →	< Comparison of the second sec				>
6 items 1 item selected 1	.04 КВ				

## 3.1.4 History Task

### Description

List all history tasks and switch between different tasks.



#### Steps

Click "Main – Task – Recent toolbox.

### 3.1.5 Close Task

### Description

User can close already opened task.

Home	Pro	Processing Reconstructio		on Tools	
د Wizard	Create	Г Ореп	Recent	(X) Close	🎄 Coordinate
		W	orkspace		



#### Steps

- Select target task node.
- Click "Main Task Close" or right click selected node to close.

Home Processing Reconstruction Tools Help Home Processing Reconstruction Tools Help Ward Create Open Recent Close Coordinate Import Remove Configure Info Workspace Process Coordinate Protect Protect				
Image: Control of the second secon				
Resources B × Trajectory B	×	GCP		5 ×
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Lat: 30.4576519; Lor: 114.4758200				
Output #	×	<		>

### 3.1.6 Coordinate

#### Description

Set the coordinate system for the current task.



### Steps

Click "Main – Task – coordinate" on toolbox.

Coordinate Settings				×	
Default Coordinate System	Coordinate System Lists	Coordinate Information			
Custom	CHC_20230725142154_NEH	Ellipsoid Projection Datum	Transform Plane Calibration Elevation	n Fitting 🔳 🕨	
DatumRoot		Method: Gaussian Projection		v	
		Projection settings	Parameter value		
		Central Meridian	111:00:00.000000	E *	
		Origin Latitude	00:00:00.000000	N -	
			Scale Factor	1	
		False Easting(m)	500000		
		False Northing(m)	0		
		Average Latitude	00:00:00.000000	N -	
		Projection Height(m)	0		
	<hr/>				
[mport Export ]	New Save Delete				
	Tere Joave Delete			OK Cancel	

• Ellipsoid: Include Name, a, 1/f and positive direction.

- Projection: Include common Gaussian, UTM, Mercator projection etc.
- Datum Transform: Include 3-parameters, 7-parameters, grid etc.
- Plane calibration: Include 4-parameters and best practice parameters.
- Elevation fitting: Include fixed difference, surface fitting, curve surface fitting and best practice. Fixed difference requires at least one starting point. Surface fitting refers to the elevation anomaly corresponding to multiple leveling points to generate an optimal surface. When the surface is parallel to the horizontal surface, the surface fitting is equivalent to fixed difference correction. This fitting method requires at least three starting points. Curve surface fitting refers to the elevation anomaly corresponding to multiple leveling normally corresponding to multiple leveling points. Curve surface fitting refers to the elevation anomaly corresponding to multiple leveling points to generate an optimal paraboloid. The curve surface fitting has a relatively high requirement on the starting data. If the fitting result is too bad, it may cause the divergence of elevation correction number in the work area. This fitting method requires at least six starting points. Best practice can input the corresponding parameters according to the real situation.
- Geoid model: Users can choose a geoid file and interpolation method according to the real situation. The software supports several kinds of geoid files, including none, CGD file, GGF file, GRD file, BYN file, GSF file, BIN file, BYN file, GDF file, JASC file and OSGB file.
- Plane grid: Supports plane horizontal east grid and plane horizontal north grid (CGD, GRD, PXY, OSGB, DAT formats).
- Note: The central longitude of the current coordinate system must be within a 24° range of the actual data's central longitude when setting projection parameters.

## 3.1.7 Import Project

### Description

Import raw project folder. There are two ways to import task, both support multiple tasks import at same time.



#### Steps

 After creating a new task, click "Main – Project – Import" or right click RawWorkspace and choose import project to load. First way is importing project from LiDAR device directly; Second way is to import project from PC local disk.



👫 Import the project	×
Mode 1 (Import from devi	ce)
Project data:	
Mode 2 (Import from disk)	
Project data:	
	OK Cancel

### 3.1.8 Import External Data

### Description

User can import other camera data.

Steps

• Right click Task and choose to import external data to load.

Home Placeship Resources Took Help Took Hel			CoPre	_ 0 ×
Projecti vindov Configure into 100 Conditione vinport Remove Configure into 100 View Configure into	Home Processing Rec	onstruction Tools Help		
tard Crew Open Recent Code Goodhale Import Remov Codegue Mo 30 Vew Output 600 Import Export Vector ID Display CCP in POSt range Cuery: Vector ID Display CCP in POSt range Cuery: Name (0) Type Refer Name (0) Type (0) Type Refer Name (0) Type (0)	2 🖪 😭 🔞	😣 🎄 🖆 🛍 🎕	i Pefault <sup>®</sup> Resources □ Trajectory 💕 了 🗸	
Notice     Diport     Notice       0 × Trajectory     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 P     0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P       Projects     0 × 0 × 0 P     0 × 0 × 0 P	Wizard Create Open Recent	Close Coordinate Import Remove Configure	Info 3D View Coutput GCP Import Export	
sources d x Tajectoy d x Tajectoy d x CP d x	workspace	Project	window vector io	
CHC_0220814803 Projects Projects Projects Reconstruction Model Channel (D) Type Refine Channel (D) Type Refine Name (D) Type	lesources d' x	Trajectory	6	X GCP 5 3
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O Error      O Warning      O Message		Output	6	×
<		😳 0 Error 🔝 0 Warning 🕕 0 Message		
<				
<				

• Choose image folder to load.

*	Import Ex	ternal Data						×
	Project Nam	e: @@2022-09-	23-144154					● Copy 〇 Cut
	Camera	Scanner						
	Image Fold	ler: //10.12.11.2	37/ftp/5Camera_l	Data/DG4/2_sl	nenyang			
	Group	Images Number	Pos Number	Model	Sensor Size	Focal Length	Import POS	Parameter
	Camera1	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera2	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera3	600	0	DG4M20	undefined	40 mm	Import	Disabled
	Camera4	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera5	600	0	DG4M20	undefined	56 mm	Import	Disabled
								OK Cancel

Click Import to import camera POS.

	Import Ex	ternal Data						×
P	roject Nam	e: @@2022-09-	23-144154					● Copy 〇 Cut
	Camera	Scanner						
	Image Fold	er: //10.12.11.2	37/ftp/5Camera_[	Data/DG4/2_sh	nenyang			
	Group	Images Number	Pos Number	Model	Sensor Size	Focal Length	Import POS	Parameter
	Camera1	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera2	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera3	600	0	DG4M20	undefined	40 mm	Import	Disabled
	Camera4	600	0	DG4M20	undefined	56 mm	Import	Disabled
	Camera5	600	0	DG4M20	undefined	56 mm	Import	Disabled
								OK Cancel

• After import, use "Separator" to divide contents. Make sure the column number is corresponded to their contents (Name, E, N, H etc.).

🖉 Tab 🔲 Semicolon 🕑 Com	ma 🥑 Space 🗌 Other			
kipped Lines: 0 🗘 Units DS Preview:	: Meter 🔍 Coo	rdinate Type: Local NEH 🔻		
Name	* N		∀ H	<b>v</b> 1
A0001.JPG	4661418.048	538002.8307	364.55602	
A0002.JPG	4661386.105	537979.3524	364.97755	
A0003.JPG	4661354.058	537956.3717	364.84507	
40004.JPG	4661320.834	537932.6661	364.27485	
40005.JPG	4661287.554	537908.4752	363.98165	
40006.JPG	4661254.733	537884.845	363.24166	
40007.JPG	4661220.993	537861.3192	362.20576	
40008.JPG	4661188.043	537838.4026	361.18411	
40009.JPG	4661155.727	537815.1116	360.43451	
40010.JPG	4661124.226	537792.1873	359.58541	
A0011.JPG	4661092.611	537770.1356	359.13554	
A0012.JPG	4661062.282	537748.2944	359.00963	



Click "OK" to import. After import successfully, choose import camera parameter to load.

😽 Se	t Camera Parameters		×
Came	ra Model: DG4M2022052A	Units: Pixel	
Fx:	9071.283308	Cx:	2957.217236
Fy:	9071.283308	Cy:	2043.806629
K1:	-0.0087138730213306	P1:	0.0000556897329903
K2:	-0.0213893558958246	P2:	-0.0002228371294037
K3:	-0.1420860940115240	B1:	0
K4:	0	B2:	0
			OK Cancel

- Click "OK" to import.
- Configure the settings of sensor size and focal length, and finally click OK.
- During process, the process bar can be displayed under raw project.

### **3.1.9 Remove Project**

#### Description

User can remove project data which include raw data, result data, preprocess data, adjust data and refined data. If choose "Delete data" during remove, then the relative data folder will be deleted.



#### Steps

- Select node part under raw project list.
- Click "Main Project Remove" or right click to remove current data.

#### Notes

For raw project, the delete option cannot be chosen by default. For processed data, user can choose whether to delete during remove.

### **3.1.10** Project config

#### Description

Used for data processing for P330Pro with 3rd party camera.

#### Steps

 Click "Project Management -> Config Project" in the main view, the Config Project window will automatically pop up;



😽 Config Project		x
Project Name:	@@2023-04-12-1315 Camera Number: 1	
Base File:	Not require	
GNSS File:		
IMU File:		
		Preprocess
Camera1		
CP File:		
Image Data: Imp	port image file's number	
Output Directory:		
	• Cc	opy 🔿 Cut
Convert Progress:	0%	Start
		Close

 Import base file, GNSS file, IMU file, click "Preprocess" to check whether the number of photos and trigger are the same.

😽 Config Proje	ect						×
Project Name:		@@2023	-04-12-1315	Camera Number:	5	w.	
Base File:		Q:/CoPre	2.7.0/904/9899	04DG4M/35183	12347C.HCN		
GNSS File:		Q:/CoPre	2.7.0/904/9899	04DG4M/20221	213030309/20	0221213030309.H	
IMU File:		Q:/CoPre	2.7.0/904/9899	04DG4M/20221	213030309/20	0221213030309.g	
		Camera r	number is:5,Trig	number is:369			Preprocess
Camera (A)	Car	mera (D)	Camera (S)	Camera (W)	Camera (X)		
CP File:							
Image Data:	Imp	ort image	file's number				
Output Directo	ory:						
						🖲 Сору	⊖ Cut
Convert Progr	ess:			0%			Start
							Close



Import CP file and image data.

😽 Config Proje	ect						×
Project Name:	:	@@2023	-04-12-1315	Camera Number:	5	Ţ	
Base File:		Q:/CoPre	2.7.0/904/9899	04DG4M/35183	312347C.HCN		
GNSS File:		Q:/CoPre	2.7.0/904/9899	04DG4M/20221	213030309/20	221213030309.H	
IMU File:		Q:/CoPre	2.7.0/904/9899	04DG4M/20221	213030309/20	221213030309.g	
		Camera n	umber is:5,Trig	g number is:369			Preprocess
Camera (A)	Car	nera (D)	Camera (S)	Camera (W)	Camera (X)		
CP File:	Q:/0	OPre2.7.0	/904/UAV P330	Opro/DG3-025-P3	30-L.CP		
Image Data:	369						
Ū							
Q:/CoPre2.7.0	0/904/	/A/A00001	.JPG				^
Q:/CoPre2.7.0	0/904/	/A/A00002	.JPG				
Q:/CoPre2.7.0	0/904/	/A/A00003	.JPG				
Q:/CoPre2.7.0	0/904/	A/A00004	JPG				
Q:/CoPre2.7.0	0/904/	A/A00005	JPG				
0:/CoPre2.7.0	0/904/	A/A00000	JPG				×
	-,,	.,					
Output Directo	ory:						
						Copy	◯ Cut
Convert Progr	ress:			0%		- 17	Start
							Close

 Select the output directory, click "Start" to convert data, wait until the progress bar to reach 100%.



😽 Config Proje	ct					×
Project Name:	@@2023	-04-12-1315 (	Camera Number:	5	7	
Base File:	O:/CoPre	2.7.0/904/9899	04DG4M/35183	12347C.HCN		
GNSS File:	Q:/CoPre	270/004/0800	04DG4M/20221	212020200/2	022121202020	
UN35THE.	Q./CoPie	2.7.0/904/9099		213030303/2	022121303030	
IMU File:	Q:/CoPre.	2.7.0/904/9899	04DG4M/20221	213030309/2	022121303030	9.g
	Camera n	umber is:5,Trig	number is:369			Preprocess
Camera (A)	Camera (D)	Camera (S)	Camera (W)	Camera (X)		
CP File:	Q:/CoPre2.7.0/	/904/UAV P330	pro/DG3-025-P3	30-L.CP		
Image Data:	369					
0:/CoPre2.7.0/	/904/A/A00001	JPG				^
Q:/CoPre2.7.0	/904/A/A00002	.JPG				
Q:/CoPre2.7.0	/904/A/A00003	.JPG				
Q:/CoPre2.7.0	/904/A/A00004	JPG				
Q:/CoPre2.7.0	/904/A/A00005	JPG				
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### 3.1.11 Refresh Project

### Description

User can refresh project if the raw project data changes.

#### Steps

Select project folder in list, then right click and choose "Refresh Project".





#### Notes

User can select RawWorkspace and right click, then choose "Refresh Project". All projects will be refresh together.

### 3.1.12 POS Accuracy Curve

#### Description

Check the accuracy metrics of pos.

#### Steps

Right click raw project to load pos accuracy curve.



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- Float/Fixed Ambiguity Status: Accuracy of Fixed Status is higher than Float Status.
- Fixed Ambiguity Status: Between 3 and 5.
- Float Ambiguity Status: Below 3.
- Quality Factor: According to the fixed ambiguity and estimation accuracy, range of values from 1-7, the smaller the better.
- **PDOP:** Position Dilution of Precision, which can reflect the distribution of satellites, range of values from 0.5-99, the smaller the better.
- Estimated Position: Represents the error of North/East/Height.
- Estimated Attitude: Represents the error of Roll/Pich/Heading.
- **Combined Separation:** Position difference values of forward and reverse solutions.
- Attitude Separation: Attitude difference values of forward and reverse solutions.



## 3.1.13 Project Detail

#### Description

User can look over detailed information of project: laser data, camera data and GPS data.



#### Steps

Click "Main – Project – Info" or right click to view details.

📽 Raw Poject Information 🛛 🕹					
@@2022-05-07-021757	Data Type	File Name	File Size	Modification Date	File Description
	✓ Scanner1				
		021859_L.pcap	3.44168 G	2022.05.07 14:44:43	Start time to end time of lidar data:2022-05-0
		AA450-833-V200-WSM-20	737 B	2022.05.07 14:40:39	System SN number:A452214833/Device SN n
		021757_S.cil	75.1172 KB	2022.05.07 14:40:39	System SN number:A452214833/Device SN n
	✓ Camera1				
		AA450-833-V200-WSM-20	724 B	2022.05.07 14:40:39	System SN number:A452214833/Device SN n
		021757_S.cil	75.1172 KB	2022.05.07 14:40:39	System SN number:A452214833/Device SN n
	✓ GPS data				
		20220822_164700646.Pos	29.9516 MB	2022.08.22 16:47:21	PosT file startTime:2022-05-07-02:18:02 ,end1
		021757_S.cil	75.1172 KB	2022.05.07 14:40:39	sync file
	L				

### **3.1.14 Open Directory**

Right click any nodes under task manager to open directory folder path.



## 3.2 Window Management

User can manage how to display all windows in CoPre.



- Layout: Click "Main Window Layout", the software interface is displayed in the default layout.
- **Resources:** Click "Main Window Resources", show or hide the resources window.
- **Trajectory:** Click "Main Window Trajectory", show or hide the trajectory window.
- **3D Viewer:** Click "Main Window 3D Viewer", show or hide the 3D viewer window.
- **Output:** Click "Main Window Output", show or hide the output window.
- **GCP:** Click "Main Window GCP", show or hide the GCP window.

## 3.3 Vector Management

### Description

The Vector Management Function includes importing, exporting, removing, and drawing capabilities. The import feature supports importing KML, SHP, or DXF files to assist in selecting tracks and modeling areas of interest. The export feature allows for exporting files in SHP or DXF formats based on the selected trajectories.



### 3.3.1 Vector Import

### Description

The import feature supports importing KML, SHP, or DXF files to assist in selecting tracks and modeling areas of interest.

### Steps

- Click on "Home -> Vector -> Import".
- After selecting a KML, SHP, or DXF file, click "OK," and the chosen file will be loaded into the track view and 3D view.



### **3.3.2 Vector Export**

#### Description

The export feature allows for exporting files in KML, SHP or DXF formats based on the selected trajectories.

### Steps

There are two ways to export vectors: exporting from loaded trajectories and exporting from selected vector nodes.



#### Method 1

Exporting from Loaded Trajectories: Choose the original project trajectories for export.

- Display the original project trajectories in the trajectory view, select the trajectories you want to export, and click on "Home -> Vector -> Export."
- Click on "Export by trajectory", choose the file format (SHP or KML), and then select the output directory to initiate the export.



### Method 2

Exporting from Selected Vector Nodes: Select a vector node for export.

- In task management, select the vect++or, then click "Home -> Vector -> Export".
- Click on "Export by vector", choose the file format (SHP or DXF), and then select the output directory to initiate the export.



### 3.3.3 Vector Removal

#### Description

This function is used to remove selected vectors.

#### Steps

- In task management, select one or more vectors, then click "Home -> Vector -> Remove".
- Confirm in the popup dialog to remove the selected vectors. You can check the option "Delete Data" to delete the vector.



## 3.3.4 Vector Drawing

### Description

This function is used to draw SHP format vectors in the 3D view.

### Steps

- Step 1: Click on "Home-> Vector -> Draw".
- Step 2: In the 3D view, use the left mouse button to click and draw. Right-click to access a menu for cancel and redrawing. Click "End" to conclude the drawing.

End(Ctrl+E) Cancel(Ctrl+Z) Redraw(Ctrl+Y) Exit(ESC)



### **Menu Description**

End (Ctrl+E): The vector's starting point and endpoint automatically connect to form a closed vector, completing the vector drawing.

Cancel (Ctrl+Z): Go back to the previous drawing step.

Redraw Ctrl+Y): Proceed to the next drawing step.

Exit (ESC): Exit vector drawing.
# 4 Trajectory View

Trajectory view interface can display POS trajectory and control points. User can select part of trajectory by point, box, polygon or timeline modes. Meanwhile, it also supports measure, meridian line display and base map display etc.



## 4.1 Display

### Description

Display project or result trajectory. If project contains control points, it will also display with trajectory on interface. This function can be used under both raw project, preprocess project, adjust, refine, and result nodes.

### 4.1.1 Display Trajectory

Select a project on left bar, then click "Trajectory –  $\leq$  " or right click project to display POS trajectory.



## 4.1.2 Hide Trajectory

User can uncheck the box of Pos to hide this trajectory.





## 4.2 Selection

User can select trajectory by point, box, polygon, or timeline modes. The selected trajectory will display red color. If select under RawWorkspace, only red part trajectory will be processed; If select under preprocess workspace, only red part trajectory will load processed point cloud data.

### 4.2.1 Point Select

### Description

User can select trajectory via points or box.

### Steps

 Choose "Trajectory – \*". For point select mode, user can short click two points to select the middle trajectory; For box select mode, user can long press left mouse to draw a box and select relative trajectories.



#### 150 m 200 ft

200 ft

## 4.2.2 Polygon Select

### Description

User can draw a polygon to select trajectory. **Steps** 

 $\bigcirc$ 

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- Choose "Trajectory " and use mouse to draw a polygon to select trajectory.
- Left mouse: Draw a point of a polygon.
- Double click: End the final point of a polygon.
- Esc button: Withdraw to previous point.



### 4.2.3 Time Select

### Description

User can select trajectory based on start time and end time.

### Steps

Choose "Trajectory – 🙆 ". Set a start time and finish time then click ok.

💐 Select Time Ra	inge ×
Project Name:	#RAW#@@2022-05-07-021757
Start Time:	2022-05-07-10:18:02
End Time:	2022-05-07-10:19:34
	ОК

### 4.2.4 Append

User can select multiple trajectories if check this option. Choose "Trajectory - 🛄 ".

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### 4.2.5 Inverse

### Description

Default is unchecking this option, which means process selected trajectory. User can also switch to inverse mode, which means process unchecked trajectory.

### Steps

 Check "Trajectory – , option then select trajectory. The selected trajectory will be displayed as black color.



## 4.2.6 Cancel Select

#### Description

User can cancel selected trajectory.

#### Steps

There are three different ways to cancel selection.

Remove the last selection



Remove all selection



Remove current highlight selection



## 4.2.7 Measure

### Description

User can measure trajectory length or multiple lines measurement.

### Steps

 Choose "Trajectory – <u></u>" and left click to select points on interface, and double click left button to stop measure. Click "Measure" again can quit measurement mode.



# 4.3 Slice

The slicing function of the track view supports the automatic display of slicing on the track and the generation of slicing reports.

## 4.3.1 Auto Slice

### Description

This function can be used on preprocess or result to show cut lines on trajectories to determine point cloud overlap status.

### Steps

 Select target project node which contain point cloud data, then click "Trajectory - — The overlap status will be displayed with different colors. User can configure the cut line parameters in settings. Finally, user can click "Trajectory – — " to output screenshots & reports.

### 4.3.2 Slice Analyze

### Description

User can click each cut line to open a slice window to check overlap status.





#### Steps

- Display POS trajectory which contains point cloud data.
- Check "Trajectory <u></u>, then choose any cut line to open a slice analyze window.

4	Profile Analysis	_ 🗆 ×
Update Width Width: 0.300 $\ddagger$	m 🕼 🔍 Horizontal: 16.216 m,Vertical: 22.381 m	
20220507102512000 20220507102605000 20220507102657000		-1
50		•
45		
40		
35		
30		
25		
	10 20	30 40 50

• User can configure the slice width to update a new slice.

<u>×</u>	Profile Analysis 🛛 🗖
Update Width Width: 0.100 🌻	m 🖉 🔍 Horizontal: 13.517 m,Vertical: 53.241 m
20220507102512000	
20220507102605000	
20220507102657000 50	
45	
10	•
40	§
	•
	•
35	
30	
25	
	10 20 30 40



*	Profile Analysis	×
Update Width Width: 0.300 📮	n 🚺 🔍 Tizontal: 5.168 m, Vertical: 2.647 m, Hypotenuse: 5.807 m	
<ul> <li>20220507102512000</li> <li>20220507102605000</li> <li>20220507102657000</li> </ul>		
45		
40		
35		
30		
25	10 20 30 40	50

User can click measure icon and hold left mouse to measure.

• User can change the view to real ratio by click magnifying glass icon.



# 4.4 Render

Set the display and rendering modes of POS track and point cloud on Track View and point Cloud view.

## 4.4.1 Render Set

This section describes how to adjust the trajectory view rendering, including adjusting the trajectory rendering type and time rendering format.

### 4.4.1.1 Render Types

### Description

CoPre 2 can display trajectory accuracy based on different attributes of POS: Quality factor, calculated satellites, fix/float, PDOP, 3D accuracy, 2D accuracy and height accuracy.

### Steps

Click "Trajectory - Select different attributes.

😽 Render Sett	ings	×
Render Type:	None	
	None	
Time Format:	Quality Factor	
	Calculated Satellites	– H
	Float/Fixed	
	PDOP	
	3D Accuracy	
	2D Accuracy	
	Height Accuracy	

### 4.4.1.2 Time Format

### Description

User can configure whether display UTC standard or absolute time.

### Steps

Click "Trajectory - since an choose whether UTC standard or absolute time.

👫 🛛 Render Setti	ngs	×
Render Type:	None	~
Time Format:	Local Time (HH:MM:SS)	
	UTC Time (1970)	Г
	Local Time (TOD)	

## 4.4.2 Map Settings

Adjust the Settings related to the offline map, including the display of the current track longitude and the import of the offline base map.

### 4.4.2.1 Show longitude

### Description

CoPre 2 can show current trajectory longitude with 3-degree or 6-degree.

### Steps

Click "Trajectory - 19 ", user can see longitude on interface, and default is 3-degree.



### 4.4.2.2 Show map

### Description

Show trajectory on map. Online map need network connected; Off-line map need built a server by enter address to download.

### Steps

For online map, click "Trajectory - 1991", the downloaded map will automatically be saved in below path (.db3). Click "Trajectory - 1991", the interface will show current location on map. For off-line map, it supports two options to load: First, load offline map by import .db3 file; Second, load offline map by server address.





Layer

User can choose which layer need to be displayed on interface.



### 4.4.2.3 Show/hide GCP

#### Description

User can show/hide different types of GCP: Check points, paired points or GCP name.

Steps

 After display trajectory, the trajectory view interface will show control points also. Click "Trajectory – Layer – Refine points" to hide this layer on interface. User can click again to activate display.





### 4.4.2.4 Show/hide direction

#### Description

CoPre 2 can show or hide trajectory direction.

### Steps

After display trajectory, user can choose to show or hide direction arrow on trajectory.



### 4.4.2.5 Show picture number

### Description

CoPre 2 can show or hide picture number.

#### Steps

• After display trajectory, user can choose to show or hide picture number.



### 4.4.2.6 Show base station

#### Description

CoPre 2 can show or hide base station.

#### Steps

• After display trajectory, user can choose to show or hide base station.



Solution Constraint Solution Constrai	
<ul> <li>Refine Point</li> <li>Check Point</li> <li>Matched Refine Point</li> </ul>	Refine Point     Check Point     Matched Refine Point
<ul> <li>Check Point</li> <li>Matched Refine Point</li> </ul>	Check Point     Matched Refine Point
✓ Matched Refine Point	<ul> <li>Matched Refine Point</li> </ul>
✓ Matched Check Point	<ul> <li>Matched Check Point</li> </ul>
<ul> <li>Show GCP Name</li> </ul>	<ul> <li>Show GCP Name</li> </ul>
Show Trajectory Direction	Show Trajectory Direction
Show KML Trajectory	Show KML Trajectory
<ul> <li>Show Picture Number</li> </ul>	<ul> <li>Show Picture Number</li> </ul>
Show Base Station	Show Base Station
20221123-053354_2 20221123-050854_1	
11	

### 4.4.3 Display Point Cloud

#### Description

User can select trajectory to display point cloud. This function is activated by default.

Steps

 After display trajectory, click "Trajectory - \* ". User can select processed trajectory to display point cloud.



# 4.5 POS skip

#### Description

In the position where the vehicle data is parked for a long time (such as equal traffic lights), the POS track may jump, resulting in the distortion of the laser data there. The POS jump repair function can smooth the skip area to solve the problem of point cloud distortion.

### Steps

When displaying the trajectory of the original project, pre-processing project, correction project or adjustment project, the software will automatically detect the skip of the POS data. If there is a skip, there will be a corresponding prompt in the output, and the jump area on the track will be displayed in different colours.





 Right-click on the POS displayed in the task management bar, and you can choose to repair POS.



 Set the relevant parameters in the pop-up repair POS dialog box, and click the confirm button to start repairing POS.

👫 Modify POS 🛛 🗙
Check Parameter Smoothing Distance (m): 20.00
Repair Parameters Convergence Interval (m): 0.010
Time Add Delete
Check Agair Repair Cancel



#### Notes

- **Smooth Distance:** Extend the threshold before and after the jump point for smoothing.
- **Detect Threshold:** The actual size of the detected jump.
- **Convergence interval:** Indicates the accuracy of POS repair.
- **Time:** POS skip repair area, which can be manually deleted or added.

# 5 3D View

Point clouds interface contains multiple functions: Point cloud render type, view, 2D/3D switch etc. User can also make a slice or measurement based on point cloud data.



# 5.1 Point Cloud Colorization

CoPre 2 supports multiple colorization functions: Height, intensity, single, RGB and strip. User can also configure the settings range and point size.

## 5.1.1 Color by Height

Click "3D View -  $\overline{\underline{1}}$ ", point clouds will be colored by height under this mode.



## 5.1.2 Color by Intensity

Click "3D View - . point clouds will be colored by height under this mode.



## 5.1.3 Color by Height & Intensity

Point clouds will be colored by intensity & height together under this mode.



## 5.1.4 Color by number of returns



Click "3D View ->■N," and the point cloud will be colored by number of returns.

## 5.1.5 Color by return number

Click "3D View -> R," and the point cloud will be colored by return number.



# 5.1.6 Color by single project

Click "3D View -> P," and the point cloud will be colored by project, different projects will be displayed in different colors.



## 5.1.7 show/hide the colorbar

Click "3D View ->■" to show/hide the color bar.



## 5.1.8 Color by Single

Click "3D View - , point clouds will be colored by different colors based on different files under this mode.



## 5.1.9 Color by RGB

Click "3D View - 👫", point clouds will be colored by real RGB color under this mode.



## 5.1.10 Color by Intensity & RGB

Point clouds will be colored by intensity & RGB together under this mode.



# 5.1.11 Color by Strip

Click "3D View - y, point clouds will be colored by different colors based on different strips.



## 5.1.12 Color Parameter Settings

User can configure parameters on "Settings". Click "Reset" to restore default settings.

👫 Settings	×
Intensity 1576	22077 🖨 Reset
Height	51 🖨 Reset

## 5.1.13 Points Size Settings

User can configure point cloud size based on these settings.



# 5.2 View Settings

User can switch multiple view angles to display point cloud data on interface.



## 5.2.1 2D/3D Switch

Click "3D View - ?", this function support 2D and 3D view switch displaying, and default is 3D display. Click it again to switch 2D view.



## 5.2.2 Direction

----

CoPre 2 supports multiple eye view directions: Front, back, left, right, top and bottom.

3D View		
💽 🗮 🔚 🦣 🚺	<b>-</b>	<b>₩</b> - <b>× ×</b>
	🗐 Front	化氯化物 化乙基酸化乙酯
	🔳 Back	
	🗊 Left	
	🗊 Right	
	🗊 Тор	
	🗇 Bottom	

## 5.2.3 Full Extent

User can "3D View - - +, to display point cloud data at center by default.

# 5.3 Point Cloud Clipping

### Description

This function is used for point cloud clipping to remove noise.

### Steps

Click "3D View -> <sup>i</sup>, " to activate the clipping command, and the clipping mode window will pop up.



### **Icon Description**

Rectangle box selection: Select point cloud data by dragging the mouse to create a rectangular selection box.

Polygon box selection: Select point cloud data by clicking the mouse to draw a polygonal selection box.

Remove Selection: Remove selected point cloud data by dragging the mouse to create a rectangular selection box.

- Interior clipping: Keep the point cloud within the selection box.
- Exterior clipping: Keep the point cloud outside the selection box.
- Clear: Undo the selection or clipping.

Save; After saving the clipped point cloud data, overwrite the original point cloud data.

 Select the rectangle (or polygon) box selection tool, draw a rectangle (or polygon) on the point cloud, and then click on " Interior clipping " (or " Exterior clipping ").
 Point cloud before clipping:



Point cloud selected by Box:



interior clipping:





Exterior clipping:



 Click "Save," then click "Confirm" in the pop-up window. When the progress bar reaches 100%, it indicates that the point cloud clipping is complete. After clipping, the point cloud data in the project will be overwritten and automatically reloaded into the 3D view.

## 5.4 Measurement

Measurement tool includes point measurement, density measurement, distance measurement, and area measurement.

# CHCNAV

### 5.4.1 Point Measurement

### Description

This function is used to measure the coordinates, RGB, intensity, time, echo, scan angle, scan direction, and point source ID of a point cloud.

Steps

Click "3D View -> 
 to activate the measurement command. Select "Point Measurement" from the pop-up menu to open the point measurement window.



Click on a point, and the measurement information for that point will then appear.

👫 Point Measurement 🛛 🛛 🗙				
Coordinate:	86.715, 3362489.075, 12.132			
RGB:	44, 46, 22			
Intensity:	5827.000			
时间:	1683251860.591			
Number of Returns:	1			
Return Number:	1			
Scan Angle:	-1.000			
Scan Direction:	0			
Point Source ID:	358			

**Note:** Point measurement is only effective for measuring the point cloud.

### 5.4.2 Density Measurement

#### Description

This function is used to measure the density of the point cloud.

Steps

Click "3D View -> <sup>(\*)</sup> to activate the measurement command. Select "Density Measurement" from the pop-up menu to open the density measurement window.



Point	시 Density	y Measurement	×
Density	Length:	1.000	m
Density	Width:	1.000	m
Line	Area:	1.000	m²
Area	Density:	330.000	pts/m²

• Set the length, then click on the point cloud you want to measure. The point cloud density information within the red box will be displayed in the window.

3D View								Ð	×
	N R	P 🛛 🍖			• ]	-\$- <b>1</b>		<b>•</b>	₩
		- Aller							
			See States	and a second					
									100
				4					
				1					
	od Densit	y Measurement		×					
	Length:	9.000	* *	) m					
	Width:	9.000		m			T (as		Carlos Carlos
	Area:	81.000		m² 					16
	Density:	204.074		] pts/m					
20.00									
			6.54						
				e series	5.99 2	15 E.			
	de la come				100				

Note: Density measurement is only effective for measuring the point cloud.

### **5.4.3 Distance Measurement**

Description

This function is used to measure distance.

Steps

Click "3D View -> \* to activate the measurement command. Select "Distance Measurement" from the pop-up menu to open the distance measurement window.

	👫 Line Measurement 🛛 🛛 😽		
✓ ✓	2D distance(m):	0.000	
Point	3D distance(m):	0.000	
Density	dx(m):	0.000	
Line	dy(m):	0.000	
Area	dz(m):	0.000	

• Step 2: Measure the distance on the point cloud by clicking with the mouse to start drawing a line and double-clicking to finish the line segment.



### 5.4.4 Area Measurement

#### Description

This function is used to measure area. **Steps** 

■ Step 1: Click "3D View -> 🔗 T to activate the measurement command, then select "Area

Measurement" from the pop-up menu.

Point
Density
Line
Area

• Step 2: Click to select points and double-click to finish drawing a closed region on the point cloud. The region will be highlighted, and the area will be displayed.



# 5.5 Select

### Description

User can use this function to pair GCP with point cloud data. Activate by default.

### Steps

Click "3D View - \*\* " to activate this function, then select point on interface. There are three ways to select:

• First, use "Ctrl" button and left mouse to select.



 Second, use "Shift" button and left mouse to draw two cross lines to select (press Esc button to cancel selection).



• Third, use "Alt" button and left mouse to draw three points to design a circle, and circle center point will be selected automatically.



# 5.6 GCP Display

### Display

User can display or hide GCP information on interface.

### Steps

Click "3D View - 🎳 " to display or hide GCP.



*	CoPre		-
Main Processing Recor	uction Tools About		
🔄 🖬 😭 🔞	🛞 🎄 🖆 🛍 🛅 🛱 Layout 🤒 Resources 📑 Trajectory		
Wizard Create Open Histor	Close Coordinate Import Remove Info 📑 3D Viewer 🖹 Output		
Task	Project Window		
esources Ø	Trainstory View Ø x 3D View Ø x	GCP Management	
CHC 20220824165726		Import GCP	Add GCP
<ul> <li>RawWorkspace</li> </ul>		Display GCP in P	OS range
@@2022-05-07-021757	d GCP Name	Query:	
Point Cloud	- Contraining	Name(ID)	Type
Images 100	Matched Point	BX01	Refine Point 3D
- POS 100	Hinkoladi Folis Humin	BX02	Refine Point 3D
10 Images POS		BX03	Refine Point 3D
- PreprocessWorkspace		BX04	Refine Point 3D
Reconstruction		BX05	Refine Point 3D
		BX06	Refine Point 3D
		BX07	Refine Point 3D
	BX08 p put pp	BX08	Refine Point 3D
	FJ14 FJ05 FJ06 BX10 BX12	BX09	Refine Point 3D
		BX10	Refine Point 3D
		U 8X11	Refine Point 3D
		BX12	Refine Point 3D
			Refine Point 3D
	• FJ02		Refine Point 30
		BX16	Refine Point 3D
		BX17	Refine Point 3D
		BX18	Refine Point 3D
		RX19	Refine Point 3D
		BX20	Refine Point 3D
		BX21	Refine Point 3D
		BX22	Refine Point 3D
		BX23	Refine Point 3D
	125 ft Lat: 30459396697.0%: 114.4785039	BX24	Refine Point 3D
	Output Ø x	BX25	Refine Point 3D
	🙆 0 Error 🔝 0 Warring 🚺 3 Messages	BX26	Refine Point 3D
	Message 2022-08-24 17/00-49 (0/02/022-05-07-021757 Scanner1) All laser data are processed.	BX27	Refine Point 3D
	Marcane 2022.08.24 12/17/11 (20:00)22.05.07 01/17/21 (arcine projection)	<	
		Н	eight Matching
	Message 2022-08-24 17:17:22 [@@2022-05-07-02:1737] Trajectory loading completed.	GCP Picture	Matched Point

# 5.7 Trajectory Display

### Display

User can display or hide trajectory on interface.

Steps

Click "3D View - i v display or hide trajectory.



# 5.8 Slices

User can make a horizontal slice based on point cloud data, which can display all points on this elevation.



## 5.8.1 Hz Slice

### Steps

 Click "3D View - A and click mouse wheel to select a location first. CoPre 2 will generate a section based on this elevation and left bottom interface will display this elevation.



**Shortcut key:** "Q": Open, "E": Exit clip mode. Press Ctrl and mouse wheel to move section.

## 5.8.2 Vertical Slice

### Description

Click "3D View - 4". User can check point cloud thickness or overlap via a vertical slice.



#### Steps

Check "V Slice", then left mouse to select two points to create a vertical slice. Press "Esc"



to cancel.



## 5.8.3 Clip Param Settings

### Description

Click "3D View - 🤧 ". User can configure thickness settings on horizontal & vertical directions. **Steps** 

• Configure settings and finally click confirm to save.

😽 Settings	×
Horizontal Thickness (m) 0.30 Step (m) 0.10	
Vertical Thickness (m) 0.30	 ▼
ОК	Cancel

# 6 GCP View

This chapter describes operations related to the control point window. It includes importing control points, selecting matching points, checking control points and other operations.

# 6.1 Import GCP

User can import GCP under raw project node, pretreatment node and result node. GCP can be used to refine trajectory or test absolute accuracy finally.

## 6.1.1 Import by control point file

CoPre 2 supports txt or csv formats file import, and make sure each line is kept corresponding. Both NEH and BLH (degree.degree & degree, minute, second) format can be read. Steps

Click "GCP window - Import GCP" to import GCP file.

GCP Management	₽ ×
Import GCP	Add GCP
Query:	

 After import, use "Separator" to divide contents. Make sure the column number is corresponded to their contents (Name, E, N, H etc.).

📱 Import GCP 🛛 🔍 🗙						
Separator Tab Semicolon 🗹 Comma 🛄 Space 🗌 Other						
Skipped Lines: 0 🐳 Unit: Meters 🔻 Coordinate Type: Local NEH 🔻						
Name	E	N ~	Н т			
BX01	545747.705	3370832.451	23.933			
BX02	545748.649	3370837.038	23.870			
BX03	545749.150	3370836.120	23.883			
BX04	545769.679	3370834.401	23.926			
BX05	545769.376	3370830.971	23.954			
BX06	545800.946	3370828.235	23.869			
BX07	545801.244	3370831.669	23.813			
BX08	545908.910	3370815.071	23.232			
BX09	545906.615	3370811.876	23.184			
BX10	545942.767	3370808.791	23.042			
BX11	545943.016	3370811.319	23.073 v			
			OK Cancel			

- Click "OK" to import GCP.
- After import successfully, both trajectory & point cloud interface will display imported GCP data.



#### Notes

If the control point file has update, support repeat import and it will cover old same name points.

### 6.1.2 New GCP

#### Description

This function cannot be used on raw project node. Need select new GCP on point cloud. This function is mainly used for two-way road data, and user can choose one side high accuracy data as control points to calibrate another side. When use such function, make sure both two-way scanning data contain this new GCP.



#### Steps

- Load solved project's trajectory and point cloud data first, then click "GCP window Add GCP" on right side.
- Activate "Select" function and press "Ctrl" button, then click left mouse to select point (Or Shift button with left mouse to select two lines for fitting). The coordinate will automatically appear after selected, finally click confirm and it will present as yellow color.

😽 🛛 Add Go	CP	×
Name:		]
Type:	3D Point	]
East:		]
North:		]
Height:		]
	OK Cancel	)

# 6.2 Select Matching points

The selection of matching points is to select points on the point cloud and match them with control points. Before the operation of correction and result accuracy verification, the selection of matching points should be carried out first. Elevation matching points can be automatically added using elevation matching points, while plane matching points and three-dimensional matching points need to be manually added.

## 6.2.1 Import paired point manually

Activate "Select" function, then select paired point on interface: Press "Ctrl" button and left mouse or "Shift" button and left mouse to draw 2 lines for fit, or "Alt" button and left mouse three time to draw a circle center point, then press "Ctrl" button with right mouse to input relative control point name and refine type, finally click confirm. The paired point display as blue color.

😽 Select Matched I	Point ×	
Name:	BX01	
Refine Type:	3D Point 🔍	
Time:	1651890371.42054	
Project Involved:	:AW#@@2022-05-07-021757	
	OK Cancel	,3D_BX01:#RAW#@@2022-05-07-021757 ,BX01

## 6.2.2 Height Matching

Height point matching is an automated process and no need to select point manually. But this function is only suitable for height points matching (This function is mainly useful for highway



data).

😽 Settings	×
GCP Neighborhood (m):	0.30
Distance To Lidar (m):	5.00
	ОК

## 6.2.3 Point Type / Correction Type Settings

• Set point type: User can set points as check point and generate accuracy report. The interval between two neighbor check points is about 100-150 m.



# 6.3 Check Control Point

This section describes how to use the imported control points to check the annotated check list, including using the control point photo to check, checking matching points and controlling point-to-point information.

GCP Picture Watched Point Check	GCP Picture	Matched Point Check
---------------------------------	-------------	---------------------

## 6.3.1 Display GCP Pictures

### Description

This function cannot be used on raw project node. User can easily select paired point based on GCP pictures.

#### Steps

First, named pictures as GCP name and save all pictures under one folder.
Click "Display GCP picture" and choose picture folder path to import. Import GCP name and display relative pictures. Roll mouse wheel can zoom in or zoom out pictures.



### Notes

If add new pictures, need re-import path to view the new pictures.

## 6.3.2 Check Paired Point

### Description

This function is used for control points and paired points checking. If neighboring control point interval exceed threshold (default 100 m), then it will be considered as abnormal control point and display as red color; if neighboring paired point error exceed threshold (default 0.05 m), then it will be considered as abnormal paired point and display as orange color.



#### Steps

 Click "Matched Point Check" on GCP window. When process is done, a report will be automatically generated.



🖡 Match	ned Point Check						×
Project Na	lame:	@@2022-05-07-02	21757	V			
GCP Dista	ance Threshold (m):	100.00	Error Threshold (m):	0.05	Check Cł	art Export	🛛 Coordinates
Name	Las Name	Neighbor Distance	DeltaX	DeltaY	DeltaZ	DeltaXY	Distance to scanner
BX03	20220507102546	9.038	0.035	0.014	-0.074	0.038	null
BX02	20220507102546	9.038	-0.017	0.010	-0.098	0.020	null
			1			L	

 User can also click "Chart" to view the linear chart of result. If it contains wave peak or wave valley, it might be the large error point and need to check whether need re-select point for matching.



## **6.4 Control Point Other Functions**

Search control point: CoPre 2 supports search function if there are multiple GCP contained.

GCP Managemer	nt 🗗	×			
Import GCP	Add GCP				
Display GCP in POS range					
Query: 12					
Name(ID)	Туре				
BX12	Refine Point	3			
🗌 FJ12	Refine Point	3			

• **Copy control point:** select one control point on the list, then right click copy. A new copy point will be added with "copy" suffix.





 Delete control point: select one control point or multiple control points from the list (Ctrl+left mouse for multiple operation, Ctrl+A for all selection). Right click delete.



 Delete paired point: select one or multiple paired control points from the list (Ctrl+left mouse for multiple operation, Ctrl+A for all selection).



• Trace control point: this function can quickly locate to target control point and zoom on.

		Сору	ł
승규가 가슴 그 가슴 가슴 가슴 눈을 들었다.	BX03		l
하는 것이 같은 것이 있는 것이 가슴을 들었다. 것이	BX04	Delete	l
같이 많은 것을 가장에 잘 가지는 것을 수 없다.	✓ BX05	Delete matched point	ĺ
	BX06	Go To	l
	BX07	Set Point Type	ſ
	BX08	Set Refine Type	
	BX09	Refine Point	
	BX10	Refine Point	
BX06	BX11	Refine Point	
	BX12	Refine Point	

Show only the control points within the current POS range



GCP Management			8	×
Import GCP		Add GCP		
☑ Display GCP in POS ra	ange			
Distance Threshold (m):	50			

## 7 Processing

This chapter introduces the main data processing process of Copre software, as shown in the figure below.

Home	Proces	sing	Reconstr	ruction	Tools	s He	elp
(A)) Cloud Base	POS	ि → Process	∰ Adjust	یے Refine	<b>e</b> Export	(I) Pause	Cancel
POS and LiDAR Processing							

## 7.1 POS Solve

## Description

If the raw project does not contain POST file, then user need to process POST file first.

## Notes

CoPre 2 use CHCNAV own algorithm to process POST. It supports two types of base static data: HCN format and RINEX 3.02 format.

## 7.1.1 Operation steps

## Steps

- Select target project under task manager list, then choose "Processing- POS."
- If the Base folder contain static data (HCN or RINEX 3.02), then software will load it automatically. User can also manually add or delete extra base station data by click "Add" and "Remove".

Settings	on dd Remove		×
Base St	ation Coordinate	Antenna Settings	
Nam	e: 3512024135H3.23o	Measured Height (m):	1.5653
CS Ty	/pe: WGS84 BLH	Measure To:	Antenna phase (
B:	30:27:10.766654 N 🔹	Antenna Phase Height (m):	1.5653
L:	114:28:45.397629 E	Manufacturer:	CHCNav
H (m	): 19.1750	Antenna Type:	CHCI50
	Select Save	Sampling Rate (s):	1.0000
Process M ◯ Tight	lode ly Coupled		
< >			More latch Setting
			OK Cancel

### Settings for loosely coupled and tightly coupled algorithms

There are two algorithms for POS processing: loosely-coupled mode and tightly-coupled mode. The loosely-coupled mode is suitable for airborne open environments, while the tightlycoupled mode is suitable for complex automotive environments.

The software will automatically select the appropriate processing mode based on the type of data. For airborne data where the performance of the loosely-coupled processing mode is not satisfactory, the tightly-coupled mode can be used as an alternative solution.

#### Notes

When multiple groups of data base station data are the same, after modified the base station coordinate, antenna settings or ephemeris data settings of a data, can click "Batch Settings" to modify the base station coordinate, antenna settings and ephemeris settings of other data in batches.

- User can configure "Enabled" option for different base stations to decide use or not use.
- Users need to set base station at a known coordinate, then manually input coordinate to get accurate result.
- Finally, click "Ok" to start POS process.

When processing data from AP5, check the POS optimization function, use SLAM and INS tightly coupled solution to improve POS accuracy, can repair POS jumping.



<ul> <li>Settings</li> <li>@@2023-05-11-024818</li> <li>Base Stati</li> </ul>	ion	×						
Cle	pud Base Add Remove							
Base	Base1 Base2							
Base	Base Station Coordinate Antenna Settings							
Na	ime: 9999532131C.23o	Measured Height (m):						
B:	30:28:20.736542 N	Measure To:						
Ŀ	114:25:28.699771 E	Antenna Phase Height (m): 0.0000						
н	(m): 38.2798	Manufacturer:						
CS	Type: WGS84 BLH	Antenna Type:						
	Select Save	Sampling Rate (s):						
POS Optin Use	nization SLAM Optimization							
		More Batch Settings						
		OK Cancel						

## 7.1.2 Add / Remove bases

### Description

If the base file is RINEX 3.02 format or HCN format, users can manually add or remove base stations.

#### Steps

 Click "Add", select the base station file, click "Open", and the software will load the base station file selected by the user.

Base Station	
Add	Remove

Select the base station to be removed, Click "Remove".

Base Station Add	Remove			
Base1 Base Station	Coordinate	斗 Prompt		×
Name:	3512024135H3.23o			
CS Type:	WGS84 BLH		Confirm to delete base	
B:	30:27:10.766654 N 🔻		station:'Base2'?	
L:	114:28:45.397629 E	-		
H (m):	19.1750			
	Select Save			



## 7.1.3 Set base coordinate

### Description

In order to ensure the absolute accuracy of the result data, the solving needs the accurate coordinates of the base station.

👫 Settings		×
✓ @@2023-05-15-(	Base Station Add Remove Recol	
	Base I         Antenna Settings           Base Station Coordinate         Antenna Settings           Name:         3512024135H3.230           CS Type:         WGS84 BLH           B:         30:27:10.766654           I:         114:28:45.397629           H (m):         19.1750           Antenna Type:         Sampling Rate (s):	1.5653       Antenna phase ( *       1.5653       CHCNav *       CHCI50 *       1.0000
< >>	Process Mode O Tightly Coupled  Loosely Coupled	More iatch Setting OK Cancel

## 7.1.4 Antenna Settings

### Description

If the base file is HCN format, user can configure the antenna settings; If the base file is RINEX 3.02 format, user can only configure "Antenna Height".

😽 Settings			×
	Station         Remove           Add         Remove           se1         se Station Coordinate           se Station Coordinate         3512024135H3.230           CS Type:         WGS84 BLH         *           30:27:10.766654         N         *           :         114:28:45.397629         E         *           4 (m):         19.1750         Ealert         Ealert         Ealert	Antenna Settings Measured Height (m): Measure To: Antenna Phase Height (m): Manufacturer: Antenna Type: Samoling Rate (s):	1.5653           Antenna phase (*)           1.5653           CHCNav           CHCI50           1           1
Proce O T	ss Mode ightly Coupled	Antenna Type: Sampling Rate (s):	More (iatch Setting)
			OK Cancel

- Measured height: Height from ground control point to base receiver. Input antenna height before static record will be read here automatically.
- Measure to: Configure 4 different method ways: slant height, vertical height, phase height and unknown.
- **Manufacturer & type**: Receiver type, read from HCN file.
- **Sampling Rate**: Static rate, read from HCN file.

Antenna Height (to phase center): If the base file is HCN format, this value is automatically calculated based on measured height, measure to and receiver antenna type, cannot manually change; If the base file is RINEX 3.02 format, this value can be changed manually.

## 7.1.5 Select From Library

### Description

User can save used base coordinate into library, or directly select from library.

### Steps

 After input base coordinate, user can click "save to library" for storage. Set the base name, coordinate, description and finally click "Save".

Settings		×
Base Station Coordinate         Name:       3512024135H3.230         CS Type:       WGS84 BLH         B:       30:27:10.766654       N         L:       114:28:45.397629       E         H (m):       19.1750         Select       Save	Antenna Settings Measured Height (m): Measure To: Antenna Phase Height (m): Manufacturer: Antenna Type: Sampling Rate (s):	1.5653         Antenna phase ( *         1.5653         CHCNav *         CHCI50 *         1.0000
Process Mode Tightly Coupled  Loosely Coupled		More latch Setting

 User can click "Select" to load stored base coordinate for next time using. Click "load" to import base information for POS process.

😽 Base Station Management 🛛 🕹						
Base Station Information						
Library:	D:/BaseStationLib	rary.db				
Base Station:	Ψ	] (	Delete	Sele	ct	
Datum:	WGS 84 .	Latitude:	00:00:	00.000000	Ν	Ŧ
Base Name:		Longitude:	)00:00:	00.000000	Е	Ŧ
Distance:	10506062.220	Ellipsoid He	eight (m): 0.000			
Description						



The base library file will be saved with .db suffix, and the default path is D:/BaseStationLibrary.db. User can also change the path & name for storage.



## 7.1.6 Ephemeris Data

User can click "More" to configure constellation system based on requirement: GPS, Beidou, GLONASS, Galileo and QZSS.

📲 Settings	×
@@2023-05-15-1     Base Station     Add     Remove     Base1	
Base Station CoordinateAntenna SettingsName:3512024135H3.230Measured Height (m):CS Type:WGS84 BLH"B:30:27:10.766654N "L:114:28:45.397629E "H (m):19.1750SaveSelectSave	1.5653         Antenna phase ( *         1.5653         CHCNav       *         CHCI50       *         1.0000
Process Mode <ul> <li>Tightly Coupled  <ul> <li>Loosely Coupled</li> </ul> </li> <li>Ephemeris Data</li> <li>GPS  <ul> <li>BEIDOU  </li></ul> </li> <li>GLONASS  <ul> <li>GALILEO  </li></ul> </li> </ul>	More [iatch Setting]
	OK Cancel

## 7.1.7 Generate POS Report

### Description

POS report can be used to check the quality of POS accuracy.

### Steps

- Select raw project on list, then right click to generate POS report.
- When the POS report generated successfully, can right-click "Open POS Report" on the original project to open the POS report.

The POS report is as follows:







**Note:** For airborne data, please display and select the track before displaying the POS accuracy report.

## 7.2 Process Data

## Description

Generate final output results: point cloud, picture, depth map, colorization. The output result data is saved under **Results** folder.



#### Steps

 Select target project (raw, preprocess, adjust or refine) on list, then click "Processing – Result" or right click to output result data. CoPre 2 design a set of different parameters for each type of project, user can directly output result or configure the settings first.



## 7.2.1 Organize Pictures

CoPre 2 can output organized pictures.

👫 Process data	×
@@2022-05-07-021757 🗹 Organize Pictures	
Time Delay (s):	0.000 Write EXIF
Point Cloud Proce	essing
Filter Settings	Sampling Rate: 100% 💌
Segment Way	File Size (Mb)
Size	300.000
Coloring 0~6	5535 👻 🗌 Remove Unshaded Points 🗹 Filter Tower Shadow
Trigger Filter Inter	val (m): 10.000 Cover Radius (m): 8.500
Mask File:	
Scanner Name	Scanner1
Camera Name	Camera1 v
Generate Result R	leport
Output Directory:	D:/CopreWorkSpace/20230403/CHC_20230406144603/Results
< >	Batch Settings
	OK Cancel

- **Time delay**: Default is 0. if exist time delay can change this setting.
- **Move pictures**: Default check, cannot cancel.
- Write EXIF: Default uncheck, this function can write position & altitude information on pictures.

## 7.2.2 Point Cloud Processing

Check the option of "point cloud processing" then the software will process laser data.

👫 Process data
$\square$
Time Delay (s): 0.000
Point Cloud Processing
Filter Settings   Sampling Rate:   100%
Segment Way File Size (Mb)
Size 300.000
Coloring 0~65535 🐑 🗋 Remove Unshaded Points 🗹 Filter Tower Shadow
Trigger Filter Interval (m): 10.000 Cover Radius (m): 8.500
Mask File:
Scanner Name Scanner1
Camera Name Camera 1 v
Concrete Desult Deport
Output Directory: D:/CopreWorkSpace/20230403/CHC_20230406144603/Results
< Batch Settings
OK Cancel



## 7.2.2.1 Filter settings

User can configure the filter settings before start process, which includes static filter and laser filter.

Filter Settings	
Static Data Filtering	
Speed Limit (m/s)	0.010
Duration (s)	10.000
Scanner1	
Туре	Scanner_LT
MTA Data	
Circle Noise Filter	Low
Field Angle Filtering	
Field Angle (°)	360.000
3D Distance Filtering (m)	
Minimum	1.000
Maximum	3000.000
Intensity Filtering	
Minimum	0
Maximum	65535
Height Distance Filtering (m)	
Minimum	-99999.000
Maximum	99999.000
Noise Filtering (m)	
Noise Distance Threshol	1.000
2D Distance Filtering (m)	
Plane Distance	99999.000

• Static filter settings: not used by default. The default speed limit is 0.01 m/s and duration are 10 sec. Software will consider such data as static data to filter based on settings.



#### Static Filter Settings

Static Data Filtering	
Speed Limit (m/s)	0.010
Duration (s)	10.000

- MTA settings: not used by default and this option only appear when process Riegl head data. User can choose whether use MTA to process.
- Circle Noise Filter: The filtering is low by default. If there is still noise after solving with MTA, you can set ring noise parameters, and there are low, middle and high-grade bits to set.

Туре	Scanner_LT	
MTA Data		
Circle Noise Filter	Low	Ŧ

Field angle filter: used by default. The default angle is 90 degrees, which means 45 degrees for both left and right side, and filer out of range point cloud data.

Field Angle Filtering	
Field Angle (°)	360.000

• 3D distance filter: used by default. This function will filter the out-of-range points.

3D Distance Filtering (m)	
Minimum	1.000
Maximum	3000.000

Intensity filter: used by default. This function will filter the out-of-range points.

Intensity Filtering	
Minimum	0
Maximum	65535

Height distance filter: not used by default. This function will the out-of-range points. The
 0 is at the center of LiDAR and upper direction is positive.



Height Distance Filtering (m)	
Minimum	-99999.000
Maximum	99999.000

Noise filter: not used by default. This function will filter the jumping noise points.

Noise Filtering (m)	
Noise Distance Threshol	1.000

 2D distance filter: not used by default. This function is used to filter point cloud data based on strip width to set overlap.

2D Distance Filtering (m)	
Plane Distance	99999.000

## 7.2.2.2 Sampling rate

CoPre 2 can set the sampling rate through the drop-down box at the sampling rate, and the sampling rate can be set to 25%, 50%, 75%, 100%. Where the default sampling rate is 100%, which means no sampling.

#### 7.2.2.3 Colorization settings

CoPre 2 can colorize point cloud data based on pictures after check "Coloring" box.

- **RGB range**: default is 0-65535, also supports 0-255.
- Remove unshaded points: default is not used. The non-colorized points will be deleted if check this option.



• **Filter tower shadow**: default is used. This function can solve the tower wrong colorization issue. For vehicle data this option is not work.



- **Trigger filter interval & Cover radius**: default values are 10 m and 8.5 m. User can configure a bigger value if faced wrong colorization (front & rear block) for vehicle data.
- Mask file: this function is only worked for vehicle data. User can import mask pictures to filter vehicle body on panoramic pictures.

🐳 Process data								
@@2022-06-19-003921 🗹 Organize Pictures								
Time Delay (s): 0.000								
✓ Point Cloud Processing								
Filter Settings     Sampling Rate:     100%								
Segment Way File Size (Mb) 🔻								
Size 3000.000								
Coloring 0~65535 🔹 🗌 Remove Unshaded Points 🗌 Filter Tower Shadow								
Trigger Filter Interval (m): 10.000 Cover Radius (m): 8.500								
Mask File:								
Scanner Name Scanner1								
Camera Name Camera 1 v								
Output Directory:         D:/CopreWorkSpace/20230403/AU20-003921/Results								
< > Batch Settings								
OK Cancel								



 Camera name: If one project contains multiple sets of camera data, user can select camera based on name and software will use this set of pictures to colorize point cloud.

Scanner Name	Scanner1	
Camera Name	Camera1	v
	Camera1	H

## 7.2.3 Depth Map

This function is only available for vehicle data and not checked by default. When both panoramic picture and point cloud were processed done, user can choose to create depth map.



👫 🛛 Process data					×			
@@2023-02-17-081908	🗹 Organize Pictures							
	Time Delay (s): 0.000	Move	Picture 🗌 Write EX	IF				
	Point Cloud Processing							
	Filter Settings Sampling	Rate: 100% 🔻						
	Segment Way	File Size (Mb)			▼			
	Size 300.000							
	□ Coloring 0~65535 ▼	Remove Unshaded	Points 🗌 Filter Tow	ver Shadow				
	Trigger Filter Interval (m):	10.000	Cover Radius (m):	8.500				
	Mask File:							
	Scanner Name	Scanner1						
	Camera Name			'				
	Depth Images Processing							
	Camera Name							
	Scanner Name							
	Generate Result Report							
	Output Directory: G:/2-Co	Pre-Project/081908/Resu	lts1					
				Batch Setting	gs			
				OK Can	cel			

## 7.2.4 Generate Result Report

• Generate Results Report: when generating the results, a result report will be generated.



🖇 Process data	×							
@@2022-06-19-003921								
Time Delay (s): 0.000								
Point Cloud Processing								
Filter Settings     Sampling Rate:     100%								
Segment Way File Size (Mb)	-							
Size 3000.000								
✓ Coloring 0~65535 ▼ Remove Unshaded Points Filter Tower Shadow	_							
Trigger Filter Interval (m): 10.000 Cover Radius (m): 8.500								
Scanner Name Scanner1	1							
Camera Name Camera1 v								
	_							
Output Directory: D:/CopreWorkSpace/20230403/AU20-003921/Results								
< > Batch Settings								
OK	el							

• The result report includes four parts: project summary, process overview, picture overview and point cloud overview. The result report is as follows:

				2022-12-19	9 16:45:25			
Project	t Su	ımma	ary:					
		Project	Name		(a	@2022-05-	07-0217	57
		CF	as		WGS84	/ Gaussian 1	Projectio	on / 114E
		Dev	vice			AA4	50	
		POS	Time		2022-05-07	02:18:02~2	022-05-	07 02:29:35
	I	Project Ca	pture Tim	e	2022-05-07 02:18:02~2022-05-07 02:29:35			
		Scanner P	RR(kHz)		NA			
	Scar	nner Rate(	scans/seco	ond)	NA			
Proces	s O	vervi	iew:					
	Р	icture Org	anize(mir	1)		2s		
	Poi	int Cloud l	Process(m	in)	52s			
Picture	e O	vervi	ew:					
Ca	imera			Numbers	Image Size		PO	OS Numbers
Ca	mera1			132	6252*416	8		132
Point C	Clou	ud O	vervi	iew:				
Scanner	r	Samplii	ng Rate	LAS Format	Cover Area (km <sup>2</sup> )	Average D (pts/m	Density 1 <sup>2</sup> )	Strisp Overlag Rate
Scanner	1	100	)%	las 1.4	0.119	340		60.92%

## 7.2.5 Other Settings

- Batch settings: this function can set all projects to a set of same parameters.
- **Output directory:** default path is Results folder and user can configure it.



× Process data ×								
@@2022-06-19-003921  Organize Pictures								
Time Delay (s): 0.000								
Point Cloud Processing								
Filter Settings Sampling Rate: 100% v								
Segment Way File Size (Mb)								
Size 3000.000								
Coloring 0~65535 🔍 🗌 Remove Unshaded Points 🗌 Filter Tower Shadow								
Trigger Filter Interval (m):    10.000    Cover Radius (m):    8.500								
Mask File:								
Scanner Name Scanner1								
Camera Name Camera I								
Generate Result Report								
Output Directory: D:/CopreWorkSpace/20230403/AU20-003921/Results								
Settings								
OK Cancel								

## 7.2.6 View Result

#### Description

After process finished, user view Codata format point cloud data in CoPre 2.

### Steps

 Select target node then click "Trajectory – " to load mission. Click on two points or hold left button to select trajectory, then the relative point cloud data will be displayed.





## 7.3 Adjust

### Description

Adjustment function mainly solves the problem of data inconsistency and improves the accuracy of data; CoPre can adjust data from both airborne and vehicle-mounted platforms.



## 7.3.1 Adjust airborne data

#### Steps

- Process the original project in the workspace node and generate the results in the resultworkspace node.
- Right-click project name in the resultworkspace node and select "Adjust" or click "Processing"→"Adjust" in the main view.

<b>*</b>		CoPre			- (d) A
Home Processing Rec	construction Tools Help				
🔮 📴 📁 🛃 POS Process Adjust Refine	Export Pause Cancel				
POS and LiDAR Pr	ocessing				
Resources # ×	Trajectory	r# ≭ 3D View	đ×	GCP	đ x
<ul> <li>CHC_20230406144603</li> <li>Projects</li> </ul>	≗ <mark>≋</mark> ©© <mark>⊞</mark> ⊒∡∡≈⊘∣≝≋∞•	11 11 11 4 12 2 4 2 14 2 4 2 4 2 4 2 4 2	1	Import GCP	POS range
▼ @@2022-05-07-02175				Query:	
Point Clouds				Name (ID)	Type Refine
<ul> <li>■ @@2022-05-07-0217</li> </ul>					
POS BOOM	Display Trajectory				
* Reconstruction	Refine				
-AT	Adjust				
DOM	AT				
Model	DOM				
	Export Result \$3397460127B				
	Open Export Directory		<u> </u>		
	Remove				
	Open Directory	A CONTRACT OF A CONTRACT.			
	1.125				
	500 ft Lat: 30.458	i2200; Lon: 114.4726310			
	Output		đ x		
	O Error 🔐 O Warning 💽 4 Messages				
	Message 2023-04-06 15:42:23 [@@2022-05-07-02175	7_Scanner1) All laser data are processed.	^	<	,
	Message 2023-04-06 15:46:38 [@@2022-05-07-02175	7] Loading trajectory		Heig	ght Matching
	Message 2023-04-06 15:46:43 [@@2022-05-07-02175	7] Trajectory loading completed.		GCP Picture	Matched Point Check

• Set adjustment parameters, select the POST modification mode.

*	🖡 Adjust				×						
	Project Name	Adjustment Data	Trajectory	File	Data Correctness						
	@@2022-05-07-021757	/Scanner1	20230206_13373	7367.Posl	ОК						
l	Slock Size(m): 100.00		Grid Size(m):	0.30	<u> </u>	1					
	block 512c(iii). (100.00			(0.50	v						
(	$\bigcirc$ Change Position $lacksquare$ Change Attitude $\bigcirc$ Change Position And Attitude										
				[	OK Cancel	J					

- Block Size(m): Block the point cloud according to the block size.
- **Grid Size(m)**: This parameter is used for resampling point clouds, thin the point cloud within the grid to one.

Note: Resampling can speed adjustment up and will not reduce point cloud after adjustment. However, do not set the value too large, which may lead to loss of key points.

- POST modification mode: There are three modification modes: Change Position, Change Attitude, Change Position And Attitude. If there is no problem with POST position or attitude accuracy, you can choose to change another item; If not sure, you can choose to change both.
- After setting the parameters, click "OK", CoPre will do the adjustment automatically.
- After adjustment is completed, the adjustment report will pop up, and generate new POS, point cloud, and log files in the ADJUST folder in the task path.

<ul> <li>マ ADJUST1</li> <li>マ 4000000000000000000000000000000000000</li></ul>						>
★ 第初     ■定到     原则     和助     和助     和助     和助     和助     和助     和助     和助     和助	(基本) (H)	新建项目 • • • • • • • • • • • • • • • • • • •	开 - 全部选择 谱 学 全部取消 史记录 一 反向选择			
5555数 ← → ◆ ↑ → 世由航 > Data	a(D:) > CopreWorkSpace > test1 > Res	me 利井 ults > @@2022-05-07-02	选择 1757 > ADJUST1		0	ク 在 ADJUST1 中提案
n drah Ba	名称 ^	修改日期	类型	大小		
3D 7df	Camera1	2023/3/29 16:50	文件来			
A360 Drive	intermediate	2023/3/29 16:50	文件夹			
1055	Scanner1	2023/3/29 16:50	文件夹			
	@@2022-05-07-021757_ADJUST1.a	d 2023/3/30 17:05	ADJUST 文件	6 KB		
■ □//	20230206_133737367.Posl	2023/3/29 16:50	POSI 文件	30,737 KB		
♪音乐						
- 桌面						
Uindows (C:)						
Data (D:)						
🚤 L (E:)						
🕳 B (F:)						
ALPHA_LAS (G:)						
🥪 G (H:)						
🥪 M0 (l:)						
ALPHA_SYS (J:)						
a1011a146700 ¥ 5个项目						

 After adjustment is completed, the adjustment report will pop up, and generate new POS, point cloud, and log files in the ADJUST folder in the task path.

26	¥ Adjust Report [@@2022-05-07-021757] ×										
Before Adjust											
	BlockName	Delta XYZ	Delta XY	Delta Z	^		BlockName	Delta XYZ	Delta XY	Delta Z	^
	All	0.037	0.010	0.033	ŧ.		All	0.019	0.003	0.018	4
	20220507102428000	0.005	0.001	0.005	(		20220507102428000	0.010	0.001	0.010	t -
	20220507102428000	0.025	0.008	0.024	¢.		20220507102428000	0.024	0.007	0.023	t -
	20220507102428000	0.007	0.001	0.007	(		20220507102428000	0.008	0.001	0.008	
	20220507102428000	0.014	0.001	0.014	(		20220507102428000	0.006	0.000	0.006	t -
	20220507102428000	0.018	0.002	0.018			20220507102428000	0.005	0.000	0.005	t
	20220507102428000	0.000	0.000	0.000	(		20220507102428000	0.017	0.001	0.017	t -
	20220507102428000	0.045	0.006	0.045			20220507102428000	0.006	0.001	0.006	t -
	20220507102428000	0.011	0.000	0.011	(		20220507102428000	0.004	0.000	0.004	t -
	20220507102428000	0.008	0.001	0.008			20220507102428000	0.018	0.002	0.018	
	20220507102428000	0.011	0.001	0.011			20220507102428000	0.013	0.001	0.013	
	20220507102428000	0.002	0.000	0.002	(		20220507102428000	0.007	0.000	0.007	t -
	20220507102428000	0.014	0.002	0.014	(		20220507102428000	0.013	0.001	0.013	t -
	20220507102428000	0.030	0.002	0.030	,~ >		20220507102428000	0.013	0.001	0.013	,×
	Export										

 After adjustment is complete, the corresponding adjustment node is generated under the resultworkspace. Users can load the point cloud after adjustment to view it. For details, please refer to 7.2.6 Viewing Results.

## 7.3.2 Adjust vehicle-mounted data

### Steps

- Process the original project in the workspace node and generate the results in the resultworkspace node.
- Right-click project name in the resultworkspace node and select "Adjust" or click "Processing"→"Adjust" in the main view.
- Set adjustment parameters, select the POST modification mode.

1	🗸 Adjust			×
	Project Name	Adjustment Data	Trajectory File	Data Correctness
	@@2022-09-06-122041	/Scanner1	20221128_223753330_correct.Posl	ОК
	Block Time Interval(s):	[5.00 🍦 G	rid Size(m): 0.30 🍦	Smooth Time(s): 5.00 🌲
(	⊖ Change Position ⊖ C	hange Attitude 🖲 Change	Position And Attitude 🗌 Adjust S	elected Time Areas
				OK Cancel

- Block time interval(s): Block the point cloud according to the set time interval.
- **Grid Size(m)**: This parameter is used for resampling point clouds, thin the point cloud within the grid to one.
- POST modification mode: There are three modification modes: Change Position, Change Attitude, Change Position And Attitude. Change Position And Attitude is selected by default, can get good result but it takes a long time. Change Position can be selected, high efficiency, but cannot get very good result. Change Attitude only is not recommended.
- Smoothing time(s): According to the smoothing time, the point clouds at the beginning and end of the time range are smoothed to ensure that there is no fault in the joint part of the adjusted point cloud and the unadjusted point cloud.
- Adjust Selected Time Areas: When checked, only point clouds within the time range of the selected trajectory are adjusted.

Note: CoPre can adjust vehicle-mounted data between multiple projects.

After setting the parameters, click "OK", CoPre will do the adjustment automatically.



## 7.4 Refine

#### Description

Refinement can reduce the error in a certain range and improve the absolute accuracy of point cloud.



#### Steps

- Process the original project in the workspace node and generate the results in the resultworkspace node.
- Import control points and select matching points on results or adjustment nodes.
- Right-click project name in the resultworkspace node and select "Refine" or click "Processing"→"Refine" in the main view.
- Set refinement parameters.



- Mode 1: Just refine position only, will reprocess pos, used for data that does not require high accuracy of attitude.
- Distance Threshold (m): If the distance between control points is less than the set threshold, then the pos position refinement value is calculated according to the adjacent control points. During refinement, the point clouds between the selected points will be refined, and the point clouds within the smooth threshold before and after the selected points will be smoothed.
- Smooth Threshold (m): If the distance between control points is more than the set threshold, the data will be smoothed.

- Mode 2: Refine both position and attitude, will reprocess pos, used for data that requires high accuracy of attitude.
- **Mode 3**: Refine point cloud (base on near control point error), the point cloud refinement value is calculated by interpolating the error of adjacent control points.
- **Mode 4**: Refine point cloud (point cloud overall offset), the whole point cloud is rotated and offset.

Note:

When choose different refinement mode, the algorithm schematic diagram and recommended usage scenario are displayed in the software window. Users can choose the refinement mode according to the actual situation of the data.

 Click "OK", CoPre will do the refinement automatically, and generate the results in the resultworkspace node after refinement is completed.



 If user selects checkpoint when selecting control points in the result or adjustment node, will generate accuracy report after refinement. Right-click the refinement node to check the report.





## 7.5 Export Results

## Description

Can export point clouds, photos and colored point clouds in the result, adjustment, refinement nodes.

Steps

- Process the original project in the workspace node and generate the results in the resultworkspace node.
- Right-click project name in the resultworkspace node and do adjustment or refinement.
- Right-click the result, adjustment, or refinement nodes to select "Export Results" or click "Processing"→ "Export" in the main view.



Select to output point clouds, images, or both, set the output directory, and click "OK".

coordinate type.	ENH Flie Format: las		
Version	1.2		~
Lat.of Origin	99:99:99.999999	N	
Lon.of Origin	999:99:99.999999	E	Ŧ
Height.of Origin	0		
🗹 Camera			
Output Directory:	D:/CopreWorkSpace/CHC_20230318		
	Version Lat.of Origin Lon.of Origin Height.of Origin Camera Output Directory:	Version     1.2       Lat.of Origin     99:99:99:99.99999       Lon.of Origin     999:99:99:99.99999       Height.of Origin     0       ✓ Camera     Output Directory:       D:/CopreWorkSpace/CHC_20230318'	Version     1.2       Lat.of Origin     99:99:99:99.999999       Lon.of Origin     999:99:99:99.999999       Height.of Origin     0       ✓ Camera     Output Directory:       D:/CopreWorkSpace/CHC_20230318 <sup>*</sup> .

- Right-click the project node to open the path for exporting results.
- **Coordinate Type**: Can select projected coordinate system, geodetic coordinate system, space rectangular coordinate system, topocentric coordinate system.
- File Format: Can output point cloud in las, laz, e57, pts format.
- Version: For point clouds in las and laz formats, there are versions 1.2, 1.3, and 1.4; There
  is only one version in e57 and pts format.
- **Output Directory**: The default output directory is...Results\Export folder, user can also change the path.Right-click the project node can open the path for exporting results.

## 7.6 Pause & Cancel

During data process, user can pause or cancel the processing step. After pause, user can click continue to keep start work.



## 8 Reconstruction

This chapter describes the main process of reconstruction. These include AT, Mark, DOM, and Model



## 8.1 Aerial triangulation

## Description

The image results generated by processing module can do AT processing, which can be used for GCP mark, DOM building and model building.

## Steps

- Select the result node generated in the preprocessing module (needs to contain image data), click "Reconstruction -> AT".
- The AT dialog box will pop up, as shown in the figure below, select the scene.
- Set the plane and height accuracy respectively.
- Click OK to start the AT processing.

😽 AT			×
Scene view view view view view view view vie			
POS Accurancy	0.010 *]	Height Accuracy(m)	[0.010 <sup>^</sup>
Plane Accuracy(m):	0.010 -	Height Accuracy(m):	0.010 -
			Cancel

 During the AT processing, the progress bar will be displayed below the result node. When the progress bar reaches 100%, the AT processing is completed, and the corresponding AT node will be added to the Resources.





• After the AT processing is completed, you can right-click the AT node and select Show Connection Point to check the matching of the image track and image after AT.



#### Notes

The image POS after AT is displayed as green color, and the image matched points are displayed as RGB color.

 After the AT is completed, you can right-click the AT node and select "AT Report" to view the AT report.





## 8.2 GCP Mark

#### Description

Import the image control points and mark the image, can optimize the AT and improve its absolute accuracy.

### Steps

Select AT node, click "Reconstruction -> Mark".



 Import control points in the GCP Management view, you can see the total number of pictures corresponding to the control point.

GCP Manage	ement				8	×
Import GCP			Add GCP			
Query:						
Name(ID)	Selected	Error	Total	Туре		^
BX05	0	0	10	Refine Point		
BX06	0	0	15	Refine Point		
BX07	0	0	14	Refine Point		
BX08	0	0	25	Refine Point		
BX09	0	0	25	Refine Point		
BX10	0	0	25	Refine Point		
BX11	0	0	25	Refine Point		
BX12	0	0	20	Refine Point		

 Double-click the control point need to be marked, the software will load the pictures thumbnail corresponding to the control point.



Click to select a picture in the thumbnail window, the selected picture will be loaded into



the Mark View, use "Ctrl + left button" to mark the point.



 After a picture has been marked, the checkmark at the corner of the picture will turn green, indicating that the picture has been marked.



 After the control point marked more than two pictures, the number of marked pictures and the marked error will be displayed in the control point list, and the control point will be automatically checked.

GCP Manage	ement				8	×
Imj	port GCP			Add GCP		
Query:						
Name(ID)	Selected	Error	Total	Туре		^
BX05	0	0	10	Refine Point		
BX06	0	0	15	Refine Point		
BX07	0	0	14	Refine Point	_	
✓ BX08	2	0.46	25	Refine Point		
BX09	0	0	25	Refine Point		
BX10	0	0	25	Refine Point		

### Notes

Only the checked control points will participate in the Aerial triangulation optimization.

 When all control points are marked, you can click "AT Optimization" to optimize the current AT node.

GCP Picture	Matched Point Check
GCP Match	AT Optimization

## 8.2.1 GCP Match

#### Description

During the GCP marking. If more than two pictures are marked, the software will predict the

position of the control point on unmarked picture. If the predicted location is very accurate, you can use the "GCP Match" function to automatically mark the unmarked pictures.

Steps

 After marking more than two pictures, the control point position of other pictures will be predicted.



 Click the "GCP Match" button, the software will automatically check all the pictures without marked.



If you find that some pictures have inaccurate marked results, you can click the check mark of the picture thumbnail, the green check mark will turn black, indicating that the picture will not participate in the AT optimization processing.



## 8.3 Build DOM

## Description

DOM result is generated from image data, which can be generated at the result node or the AT node.

## Steps

• Select a result node (need to contain image data) or AT node, click "Reconstruction -> DOM".



 Set the relevant parameters in the pop-up window, click OK, the software will start DOM processing.

👫 DOM	x
Data Source	
🗌 Lidar	🗹 Image
Mode Settings	
High Efficiency	It can quickly generate results, and the effects of buildings, water areas and so on in the results are general.
<ul> <li>High Quality</li> </ul>	It takes a long time to output good and high-quality results.
Scene Settings	
DOM Settings	
Adaptive Resolution	
Oustom Resolution (m):	0.05
Output Path: E:/TEST/CHC_	20220805204143/Results
	OK Cancel

- Data source: Select according to the corresponding data, the lidar can only be selected in the high-efficiency mode, and the image is a required option.
- Mode settings: Contains two modes: high efficiency and high quality. High efficiency generates DOM faster, but the effect is poor, and high-quality generates DOM at a slow speed and better effect.
- Scene settings: There are three scenes including city, mountain and plain, which can be selected according to the actual data scene type.
- DOM setting: If you check adaptive resolution, the software will automatically calculate the resolution of the DOM, if you check custom resolution, the software will output the DOM according to the set resolution.

#### Note

1. If the DOM is generated at the AT node, only resolution setting can be selected, other settings are not visible.

2. In the high-efficiency mode and the data source of lidar is selected, the AT processing will not be performed, and the scene settings will not be visible.

 After the DOM processing is completed, the corresponding DOM node will be generated. You can right-click the DOM node to select load DOM, and the software will automatically load the DOM data corresponding to the current node.






## 8.4 Build Model

#### Description

Model result is generated from image data, can only be generated at the AT node.

### 8.4.1 Single Mode

#### Steps

Select a AT node, click "Model".



 Set the relevant parameters in the pop-up window, click OK, the software will start Model processing.

😽 Model			×
Data Source	☑ Image		
Mode Settings High Efficiency High Quality	For generating result qucikly, the effe For generating the quality results nee	ct of building & water area v d more time.	vill be poor relatively.
Process Mode Single Mode Cluster Mode Se	ttings		
Tile Adaptive Tile Size Custom Tile Size (	m): 100.00 🗘 Confirm Predicted n	nemory usage: 0.0 GB.	
Select Interest Area All Area Select Area			
Output DOM Advanced Settings			
		TLOIL	
<ul> <li>Adaptive</li> </ul>	X (m): 0.000 Y (m): 0.000	<ul> <li>Adaptive</li> </ul>	X (m): 0.000 Y (m): 0.000
○ Custom	Z (m): Can't be set	O Custom	Z (m): Can't be set
Output Path: E:/Cop	reWorkSpace/111E/Results		OK Cancel

- Model settings: Including tile settings, coordinate origin settings, block settings, and output DOM.
- Data source: Select according to the corresponding data, Lidar can be checked, image data source is required.
- **Process mode:** Includes single-machine deployment mode and cluster deployment mode.
- Tile: There are two methods: adaptive and custom. When "adaptive" is checked, the software will automatically calculate the appropriate tile size according to the current remaining memory of the computer. When "Custom" is checked, the software will calculate the required memory consumption according to the current size of the tile and click the "Confirm" button on the right.

- **Output DOM:** When building model, you can output DOM incidentally. When checked, the DOM data will be output after the model is built.
- After the Model processing is completed, the corresponding Model node will be generated.
   You can right-click the Model node to select load Model, and the software will automatically load the Model data corresponding to the current node.



## 8.4.2 Cluster Mode

#### Steps

Select a AT node, click "Model".

Model			
Data Source	✓ Image		
Mode Settings High Efficiency High Quality	For generating result qucikly, the effe For generating the quality results nee	ct of building & water area v ed more time.	vill be poor relatively.
Process Mode Single Mode Cluster Mode	ettings )		
Tile • Adaptive Tile Size • Custom Tile Size	e (m): 100.00 🗊 Confirm Predicted r	nemory usage: 0.0 GB.	
Select Interest Area			
<ul> <li>Output DOM</li> <li>Advanced Setting</li> </ul>	s		
Coordinate Origin —	X (m): 0.000 Y (m): 0.000	Tile Origin Adaptive	X (m): 0.000 Y (m): 0.000
○ Custom	Z (m): Can't be set	<ul> <li>Custom</li> </ul>	Z (m): Can't be set
Output Path: E:/Cop	oreWorkSpace/111E/Results		OK Cancel

 Select the "Cluster Mode" and click "Settings" to pop up the cluster settings dialog box, which will automatically read the machines in the local area network with the cluster



service turned on, where the node IP and cluster ID is displayed on the left. Click the machine IP that needs to be the child node of the engineering task, click "Add" to join the node, and click "OK" after the configuration is finished.

😽 Node Management				×
Avai	lable		Config	gure
Node IP/Group ID	Host IP	Add	Node	e IP
group1			10.12.11.39	
group2		Remove	10.12.11.81	
group3			10.12.11.213	
		Remove All		
Refre	sh		Yes	Close

• **Node status:** Used to view the running status of each node.

*		Clu	ster Execution Sta	atus		-	□ ×
Node State	Task State	Reset Node	Refresh	Settir	ngs (	Output Efficiency St	tatistics
Node	Cause Of Error	Task Status	Task Name	Task Type	Block Number	Start Time	Run Tin
10. 12. 11. 81 10. 12. 11. 39		Running Running	Tile_+001_+ Tile_+000_+	Reconstruct <sup></sup>	Tile_+001_+ Tile_+000_+	2022-12-09 ···· 2022-12-09 ···	



• Task status: Used to view the overall running status of the task.

*		Cl	uster Execution Sta	atus			- 🗆 ×
Node State	Task State	Reset Node	Refresh	Se	ttings	Output Efficiency	Statistics
Task Name	Running Node	Task Status	Start Time	End Time	Block Number	Task Type	Task File
Tile_+001 Tile_+001 Tile_+000 Tile_+000 Tile_+000 Tile_+000 Tile_+000 Tile_+000	10. 12. 11. 81	Non-Execution Non-Execution Running Non-Execution Non-Execution Non-Execution Running	2022–12–09 ···· 2022–12–09 ····		Tile_+001_+001 Tile_+001_+001 Tile_+001_+000 Tile_+001_+000 Tile_+000_+001 Tile_+000_+000 Tile_+000_+000 Tile_+000_++***	Reconstructio" Reconstructio" Reconstructio" Reconstructio" Reconstructio" Reconstructio" Reconstructio" Reconstructio	//10.12.11.2 //10.12.11.2 //10.12.11.2 //10.12.11.2 //10.12.11.2 //10.12.11.2 //10.12.11.2 //10.12.11.2

### 8.4.3 ReMode

#### Steps

Click" ReModel" on the model node.



Notes:

The modeling data needs to be reloaded after remodel.

## 9 Tools

Home	Processing	Reconstruction	Tools	Help
	R.		2	ta l
Data Copy	Data Check	Points Optimize	CS Manager	Mask
		Utility Tools		

## 9.1 Data Copy tool

The data copy tool can automatically copy raw data from the device.

### Steps:

Different devices have different data storage disks. For details, please refer to the user manual of the actual device in your hand.

 Connect the data storage card with card reader to the computer, the computer will pop up disk ALPHA\_SYS.



 Connect the camera to the computer with the type-C cable, the computer will pop up two disks: CAM\_M and CAM\_SYS.



Click "Tools->Data Copy";



Select the corresponding parameters:



📕 Data Copy		_ ×
Type AU20 SN S09999020037 Carrier UAV_BB4   Project Select All	SYSTEM Connect failed	€ Reload Format USB Exit
	Output:	Сору

 For current AU20, AlphaPano and AA10 units, please manually select the mount carrier before data copy.

Select Carrier			×
Project @@2023-05-20-041640(BB4)	Select Devic Module1:	æ: BB4	У
	Module2: Module3:	AU20 C5	т Т Т
			Batch Setting Finish

- If you have selected the user defined carrier type option, you need to manually set the parameters.
- Set parameters as shown below. For details, please refer to the user manual of the actual



device in your hand.

arrier Type:	Ground Vehicl	е	Carr	ier Name			
Lever Arm O	ffset (Sensor M	easur	ement Origin t	o Antenn	a Phas	e Center;Unit	: meter)
Tx: 0.0000	-	Ty:	0.0000		Tz: 0.	0000	
A							
A-port to t positive, up	he horizontal di oward is negativ	· rectio /e)	on rotation(Dov	wnward is			

 After setting up, you can check the project data of the device in the data column on the left. Select one or multiple sets of data, and you can see the corresponding camera, laser and GPS data on the right side.

ype AA450	SYSTEM	1.65GB is available	LIDAR 1.	65GB is available	CAMERA 10.52GB	is available 😶 R	teload
N E042116048					Stored: 923,can store: "	1078	ormat
Carrier UAV_M300 v						<u>R</u> . u	JSB Ex
	Camera Sca	inner POS					
@@2021-04-28-023807							^
@@2021-04-28-021544				De			
	DSC000	59 DSCC	00060	DSC00061	DSC00062	DSC00063	
		IN MARKE					
	S			D	D	D	
	DSC000	64 DSCC	00065	DSC00066	DSC00067	DSC00068	
					SHER / P		
	11-1			D	1 Da		
	DSC000	69 DSCO	00070	DSC00071	DSC00072	DSC00073	`
	Output:						
		1009	% Match project da	ta finished.		Сору	

#### Notes

- Double-click on a photo to view the current photo.
- Create the directory and select the copy path.



Click the copy button, CoPre will automatically copy the selected sets of data.



• After all sets of data are copied or the storage space is insufficient, you can click the format icon in the upper right corner to format the disk.

Data Copy	<b>—</b> r	<b></b>	_ ×
Type         AA450           SN         E042116048           Carrier         UAV_M300	SYSTEM	A 10.52GB 1.65GB is available 923,can store: 1	is available C Reload
Project		1.000	
@@2021-04-28-023807 @@2021-04-28-021544	LIDAR ALPHA_LAS(I;/)	1.65GB is available SC00062	DSC00063
		10.52GB is available SC00067	DSC00068
	Please select disk to format	Format SC00072	DSC00073 V
0	stput: E:/TEST 100% Match pr	oject data finished.	Сору
Picture number: 447 Collect time(min): 20.9	Missing picture number: 0 Missing POS numb	er: 0	

## CHCNAV

## 9.2 Data quality check

### Description

Used to detect data loss and jump of Lidar and IMU and detect whether the images are missed. **Steps** 

Click "Tools→Data Check", the data check window will automatically pop up;



Click "Import" button to import the data to be checked.



- Check the items to be checked, including Lidar data, camera data and IMU data, then click" Check "button.
- Wait until the progress bar reaches 100%, click can open the "Source Data Quality Report", as follow:



## **Source Data Quality Report**

#### 2023-03-30 11:09:43

#### 1. Project Summary:

Project Name	@@2023-03-28-083456
Collect Time(min)	19.124

#### 2. Camera Statistics:

Camera	Number of Images	Number of Trigger	Status	
Camera 1	186	186	Pass	

#### **3. Scanner Statistics:**

Scanner	Lidar File	Start Time	Stop Time	Status
Scanner1	20230328_083834_000.1tp	8:38:41	8:44:04	Pass
Scanner 1	20230328_083834_001.1tp	8:44:04	8:49:25	Pass
Scanner1	20230328_083834_002.1tp	8:49:25	8:51:00	Pass

#### 4. IMU Statistics:

IMU File	Status
20230328_083456_I.imr	Pass

**Import:** Import the data to be checked, can import multiple projects at the same time.

### Lidar data check:

(1) AA450( $lv_{\gamma}$  pcap format): If the data packet is lost for more than 100 and time jump more than 0.0125s, Copre decides there is a problem with this data.

(2) Hesai XT16、 Hesai XT32(pcap format): If the data packet is lost for more than 100 and time jump more than 0.02s(XT16), 0.01s(XT32), Copre decides there is a problem with this data.

(3) Riegl: If the data packet is lost for more than 1 and time jump more than 0.3s, Copre decides there is a problem with this data.

(4) LT: If the data packet is lost for more than 1 and time jump more than 0.1s, Copre decides there is a problem with this data.

#### camera data check:

Check the CHCNAV self - developed camera and Ladybug camera to see if the number of photos and TRG is the same.

- IMU data check: If the Imr data packet is lost for more than 1 second and time jump exist, CoPre decides there is a problem with this data.
- Check: Click" Check" button to start checking data.
- Delete: Right-click the imported project to delete the selected project.

## 9.3 POS Optimize

### Description:

When processing data from AP5, check the POS optimization function, use SLAM and INS tightly coupled solution to improve POS accuracy, can repair POS jumping.

### Steps:

Click Tools → POS optimize;

Home Proces	sing Reconstruction	Tools	Help		
Data Copy Data Che	ck POS Optimize Points C	ptimize CS N	<b>&amp;</b> Manager	🔄 Mask	
	Utility Tools				
😽 🛛 POS Optimize	: 🤳 .				×
Tips: This tool is a	only applicable to POS optin	nization using	Alpha Pan	o's SLAM	data.
Project Path :	G:\@@2023-05-11-024818	}			
I					
PostFile Path:	24818\GPS\Post\@@2023-	05-11-024818	IE.PosT		
	21010/010/1 001/2/22020				
ImuFile Path :	5-11-024818\GPS\Rover\2	0230511_0248	318_1.imr		
I					
I		ſ	OK	Can	cel
			UK		

- Choose the project file path, and CoPre will automatically detect the paths of the Post file and IMU file.
- Check if the automatically selected post file is the one to be optimized. Once confirmed, click "OK".
- After the progress bar is completed, a Post file with the \_SLAM suffix is generated under the selected Post file path, that is the optimized file.

## 9.4 Point cloud thickness optimization

### Description

Only used for data from AA450(AA450Pro), Alpha3D, VA3 and AU10, can reduce the thickness of point cloud.

Steps

Click" Tools→Point Cloud Optimize", the Point Cloud Optimize window will automatically



pop up;

	Hom	ne	Proce	essing	Re	econstruct	ion	Tool	s	Help		
								2		ta l		
	Data	Сору	Data	Check	Poin	its Optimi	ze C	S Mana	ger	Mask		
					Utili	ty Tools						
😽 Point	Cloud Optim	nize										×
		Tips: Thi	s tool only s	supports AA45	0, Alpha3I	D (multi-line laser), '	VA3, and	AU10 data pro	cessing			
Coordina	ate Type:	ENH		▼ Carr	ier Type:	Car	,	v				
PosL File												
Source F	iles:											
									_			
Optimize	e Settings:	Grid Sa	ampling (	Grid Size (m):	0.05		M	lax Thick (m):	0.90			•
		Merge	Files F	File Formart:	las		V					_
Output E	Directory:					00/						$\exists$
Optimize	e Progress:					0%					Start	$\exists$
											close	

- Set Coordinate Type and Carrier Type.
- Import the point cloud that needs thickness optimization, can import las, laz, and codata format.
- Set thickness optimization parameters, including Grid Sampling, Grid Size (m), Max Thick (m), Merge Files and File Format, please see detailed parameter description below.
- Set Output Directory.
- Click Start to start thickness optimization, wait until the progress bar reaches 100%, can check the result in the PointCloudRefine folder of the Output Directory path, as follow:

< → < ↑ <a>&gt; ₩</a>	11脑 > 新加巻	(H:) > 1-project > 025403 > Re	sults > Export > @@2022-03-0	3-025403_s → AUTOS	OLVE > Scanner1 > PointCloudRefine	✓ C 在 Poin_ ₽
业 下载		名称	修改日期	後間	大小	
🔤 文档	*	🚞 Tmp	2023/3/24 20:10	文件夹		
▶ 图片		Section 20 Contract 10 Contrac	2023/3/24 20:09	LAS Laser Point	179,157 KB	
> 高学	*	👻 0_1_filtered.las	2023/3/24 20:09	LAS Laser Point	26,905 KB	
000000000		👻 1_0_filtered.las	2023/3/24 20:10	LAS Laser Point	145,972 KB	
021757		👻 1_1_filtered.las	2023/3/24 20:10	LAS Laser Point	12,225 KB	
PointCloudRefine						
Scanner1						
OneDrive - Personal						
📮 #19.16						
19.50						
四日 四日						
■ 文档						
🛓 下载						
0 音乐						
直 桌面						
) 🏪 系统 (C:)						
) 🕳 欽仲 (D:)						
) ((= 文档(E:)						
· ()** 安装 (F:)	I					
Be Data (G:)						
-						

- Coordinate Type: Can select projected coordinate system, geodetic coordinate system, space rectangular coordinate system, topocentric coordinate system, the default is projected coordinate system.
- **Carrier Type**: Can select UAV or Carset, the default is UAV.
- **PosL File**: Point cloud form car set need import PosL file.
- **Source Files**: Import the point cloud that needs thickness optimization, can import las, laz, and codata format.
- **Grid Sampling**: Check by default.
- Grid Size (m): Need to check Grid Sampling first, the bigger the value, the less the point cloud.
- Max Thick (m): He upper limit of point cloud thickness that the algorithm can optimize, the optimization result may not be good for point cloud whose thickness exceeds this value.
- Merge Files: Check by default, point cloud after thickness optimization will be merged into one file.

## 9.5 CS Manager tool

This function is used to convert coordinates, users will see a pop-up converting interface.

Coordinate Converter							
Project Coordinate System Setting Calculate Parameters	Coordinate Transform Frame Conversion About						
Source Coordinate System	Quick Operator Target Coordinate System						
© Geocentric	Basic Datum Parameters     Geocentric						
Geodetic dd°mm'ss.ssssss"	Horizontal Parameters     Geodetic dd°mm'ss.ssssss"						
	Vertical Parameters						
U Plane	Plane Grid						
Ellipsoid Name WGS84	Geoid Grid     Ellipsoid Name     WGS84						
Lat 00°00'00.000000"N Lon 000°00'00.000000"E	Single Pt Convert>         Lat         00°00'00.000000'N <inv convert<="" pt="" single="" td="">         Lon         000°00'00.000000'E</inv>						
Н 0.00000000	Н 0.00000000						
File Format	Batch Convert     File Format        File     Export						

The menu bar includes five options: project, coordinate system settings, calculate parameters, coordinate transform, frame conversion and help.

## 9.5.1 Project

 New File: Click on it to create a new project, users can select the storage path and click Confirm to finish.

#### Notes

The default path can't be changed, otherwise it can't be read.

- **Open File:** Click to open the existed project file.
- **Save:** Click to save the current project.
- Save as: Click to save the project in another path and rename it.
- Exit: Click to quit the current operations

## 9.5.2 Coordinate system settings

An interface for coordinate setting will pop up after clicking **[Coordinate setting]**, users can configure all parameters about the system.

Coc	ordinate Syster	n Settings						 ×
Ell	lipsoid Proje	tion Dat	tum Transform	Plane Calibration	Elevation Fitting	Geoid Model	Plane Grid	
Elli	ipsoid Name:	WGS84						•
^	Ellipsoid							
	Name			WGS84				
	а			6378137				
	1/f			298.257223563				
	Positive Dire	ction		NorthEast				~
-								
:								
H								
	Select							 Confirm Cancel

## 9.5.3 Calculate Parameters

The calculation parameters include datum transference parameters, plane adjustment parameters, and height fitting parameters.

neters Calculation			
imeter Type:			
sulation Method:			
Add Delete Import Format: dd°mm'ss.ssssss" •	Calculate	Export Setting	Export
Select Source Name Source(Lat) Source(Lon) Source(H) Target Name Target(n) Target(e) Target(h)		Result	
		Confirm	Cance

- Datum Transference Parameters: there are three calculating methods including 3parameter, 7-parameter, and strict 7-parameter for datum transference parameters.
- Select parameter type, calculating method and set the data format, then click [Add] to add points to calculate.

Par	rameters Calculatior			×
P	arameter Type:	Datum Trans Params		•
c	alculation Method:			-
		3 Params		
		7 Params Strict 7 Params		
	# Select Source N	Sunc / Faranna		
			-Confirm - Confirm	Cancel
L				

- Set the related parameters and add points, then click [Calculate] to finish.
- Plane Adjustment Parameters: there are 4-parameter and best practice for plane adjustment. 4-parameter contains four parts of North offset, East offset, rotation angle and scale factor. Users should set the related parameters and add points, then click [Calculate] to finish.

Parameters Calculatio	n		×
Parameter Type:	Plane Adjustment		•
Calculation Method	: 4 Params		-
	Add Delete Import Format: dd°mm'ss.sssss" • Calculate Ex	port Setting	Export
# Select Source	Name   Source(Lat)   Source(Lon)   Source(H)   Target Name   Target(n)   Target(e)   Target(h)   Horizontal Residual	Result	
		Confirm	Cancel

- Height Fitting Parameters: include four options of fixed difference, plane fitting, curve fitting and best practice.
- **Fixed difference:** need at least one point.
- Plane fitting: need three points at least.
- **Curve fitting:** need at least six points.
- Best Practice: it adopts transference model from TGO, includes five parameters, north origin point, east origin point, north slope, the east slope and the high difference constant. Users should set the related parameters and add points, then click [Calculate] to finish.

Parameters Calculation X					
Parameter Type:	Height Fiting Params	•			
Calculation Method:		•			
	Fixed				
	Plane Fitting				
# Select Source	Curve Fitting				
	Best Practice				
		Confirm Cancel			

- **Import**: Click to import the conversion data.
- **Export setting**: Click to set the content of the export file.
- **Export**: Click to export the conversion parameters.

## CHCNAV

## 9.5.4 Coordinate transform

Single Pt Convert: This refers to the converting between single points. Confirm the source coordinate system parameters, type, conversion method, target coordinate system parameter, and then users can click [Single Pt Convert] to finish converting.

&	_	Coordinate Converter	_ ×
Project Coordinate System Setting Calculate Parameter	ers C	Coordinate Transform Frame Conv	version About
Source Coordinate System		Quick Operator	Target Coordinate System
© Geocentric		Basic Datum Parameters	© Geocentric
Geodetic dd°mm'ss.ssssss"	•	Horizontal Parameters	Geodetic dd°mm'ss.ssssss" •
© Plane		Vertical Parameters	© Plane
		Plane Grid	
Ellipsoid Name WG584	<u> </u>		Ellipsoid Name WG584 ·
Lat 00°00'00.000000"N			Lat 00°00'00.000000"N
Lop 000°00'00.000000"E		Single Pt Convert>	Lon 000°00'00 000000"E
		<inv convert<="" pt="" single="" td=""><td></td></inv>	
Н 0.00000000			Н 0.00000000
File Format			
		Batch Convert	Hie Format

Inverse Single Pt convert: This refers to the inverse-converting between single points. Confirm the source coordinate system parameters, type, conversion method, target coordinate system parameter, and then users can click [Inv Single Pt Convert] to finish converting.

&	Coordinate Converter	_ ×
Project Coordinate System Setting Calculate Parameters	Coordinate Transform Frame Conversion	on About
Source Coordinate System © Geocentric © Geodetic dd°mm'ss.sssss" © Plane	Quick Operator       Ta         Basic Datum Parameters       ()         Horizontal Parameters       ()         Vertical Parameters       ()         Plane Grid       ()	arget Coordinate System Geocentric Geodetic dd°mm'ss.sssss" Plane
Ellipsoid Name         WGS84           Lat         00°00'00.000000"N           Lon         000°00'00.000000"E           H         0.000000000	Geoid Grid  Single Pt Convert>  CInv Single Pt Convert	Iipsoid Name         WGS84         •           Lat         00°00'00.000000"N
File Format	Batch Convert	le Format

 Batch Convert: This is used to batch convert the coordinates. Firstly, confirm the source coordinate system parameters, type, conversion method, target coordinate system parameter that is set in Coordinate System Setting, target coordinate system type and file formats, then click to the interface of modifying file format.



Format Edit					×
Information Separator Comma	_	•			
Predefine Name Code Lat Lon H X Y Z n n		Add PlaceHolder Revert Clear	Preview		
				Confirm	Cancel

- Set the file format and click **[Import]** to choose files needed to batch convert.
- Choose the target file, click [Open] to import it. Later, then click [Batch Convert] in the.
   After the conversion set the format and path to export.

#### Notes

Please keep the format of setting files and chosen files are in common. Otherwise, it will fail.

- Import Conversion File: Click to import conversion files for batch converting.
- Export Conversion File: Click to export conversion files after batch converting. Input file
  name and click Save to save it.
- **Export File Format Editor**: Click to set the format for the batch conversion files.
- Conversion Report: Click to save the corresponding report. Users should input a name for report and press button Save.
- Conversion Report Config: Users can configure parameters for the report and click Confirm to finish.

## 9.6 Mask tool

#### Description

User can create a mask file to filter vehicle body for panoramic pictures.

#### Steps

- Click "Tools Mask Tool" to open panoramic image mask tool interface.
- Click "Load Pano" to import a panoramic picture first. Then use "Ctrl" button with left mouse to draw on picture to filter vehicle body. Use Ctrl button with right mouse can cancel last step.



• After finish drawing, click "Start Mask" to create a mask picture. User can click "Reset" to recreate one.



Finally, click "Save Template" to save this mask file and the file name is "MaskImage.jpg".



## **10** Software Helper

User can check more information about software on "About".

. 📀		$\bigcirc$	(20)	i
Language	Manual	Updates	License	About
	Softw	vare Helpe	er	

## 10.1 Language

User can switch software language here: Chinese, English and Russian.



## 10.2 Manual

User can find latest software user manual under this option.

## 10.3 Update Info

User can check release note about new features and solved bugs.



## 10.4 License

User can check software license and machine ID under this option.

😽 License		×
Expire Date: 09-11-2022	Current Date:	24-08-2022
Hardware Information:		
4237711156		
User Name:		
License:		
		Register

## 10.5 About

User can check current software version and detect latest version to upgrade.

🐳 About 🛛 🗙						
CoPre						
Version: 2.5.0 Beta Update						
Automatically check for update						
Warning: This computer program is protected by copyright law and international treaties. Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted under the maximum extent possible under law.						
Copyright: Shanghai Huace Navigation Technology Ltd.						

## **11 Common Shortcut Keys**

This chapter describes the shortcut keys commonly used in trajectory view, three-dimensional

view, and control point view on the CoPre main interface.

## **11.1 For Trajectory View**

- Mouse wheel: Zoom in/out POS trajectory.
- Mouse right button: Long press to move POS trajectory.
- Space button: Full screen trajectory.
- Ctrl + Mouse left button: Finish polygon select/distance measurement.
- Esc: Undo the last option during polygon select/distance measurement.

## 11.2 For 3D View

- Mouse wheel: Zoom in/out point cloud data.
- Mouse left button: Rotate point cloud data.
- Mouse right button: Move point cloud data.
- Double click left mouse: Centered mouse location.
- Space button: Full screen point cloud data.
- Ctrl + Mouse left button: Select one point under paired process.
- Shift + Mouse left button: Select intersect point based on two lines under paired process.
- Ctrl + Mouse right button: Pop on paired point window after select points.

## **11.3 For Cross Section View**

- Shift + Mouse left button: Select two points and measure distance.
- Mouse wheel: Zoom in/out point cloud data.
- Mouse right button: Move point cloud data.
- Double click left mouse: Centered mouse location.
- Space button: Full screen point cloud data.

## 12 Others

This chapter introduces the data processing flow of some special radars.

## 12.1 Laser data processing of AA1400/AA2400/VZ2000i

### Description

Add laser data processing function of AA1400/AA2400/VZ2000i in CoPre 2 need to install thirdparty SW.

Step

 Prepare RiUNITE-1.0.3 software package, RiUNITE-1.0.3 software License, and RiUNITE 1.0.3 dongle.



Double-click SetupRiUNITE.exe to install with default Settings.



After the SW is successfully installed, open the LicenseCenter from the Start menu bar.





Click "Import..." , import .lic file.

reatures and	icenses				Serial number	Valid until	Statu	5	^	Impor	t	
Bathymetr	y Tool Set	t								Add.		
📧 Embedder	d Kinemat	ic LiDAR Da	ata Acquisitio	n						n 1 .		
📧 Embedder	d Kinemat	ic LiDAR Da	ata Acquisitio	n Light						Detet	e	
Full Wavef	orm Analy	ysis Bathym	etry						⊠ S.	how all	featur	es
Full Wavef	orm Analy	ysis Topogr	aphy									
Full Wavef	orm Analy	ysis Topogr	aphy with GP	U Support				_				
Import												3
→ <b>•</b> ↑	→ 此目	电脑 → USE	3 DISK (G:) >	LICENSES		~	5	p :	搜索"LIC	ENSES		
」訳▼ 新建	文件夹									-		?
此电脑	^	名称		^		修改日期		类型			大小	
👕 3D 对象		RiUN	ITE-1.0.3-inst	all		2022/3/31 1	:20	文件	夹	_		
📕 视频		Licen:	se_TianGIS_SI	N S2227161	_dongle 8306.lid	2021/10/28	5:56	LIC	文件			1 K
🔮 文档	- 11											
↓ 下戦												
***												
1) 百乐												

Click "Save/apply changes now!".

censes Additional Messages					
Features and licenses	Serial number	Valid until	Status	^	Import
Bathymetry Tool Set					add
Embedded Kinematic LiDAR Data Acquisition					Add
	A S2227161	2022-12-09	Maintenance		Delete
Embedded Kinematic LiDAR Data Acquisition Light					🗹 Show all feature
Full Waveform Analysis Bathymetry					
Full Waveform Analysis Topography					
Full Waveform Analysis Topography with GPU Support	rt				
Georeferencing					
Georeferencing Light					
Kinematic LiDAR Data Acquisition					
Kinematic LiDAR Data Processing					
🔟 Kinematic LiDAR Data Processing Light					
Kinematic LiDAR Extended Data Processing					
🗾 LIS GeoTec					
LIS LiDAR Point Cloud Classification ALS					
MTA Resolution					
🤌 manana araanaa karaa karaa karaa	306 3306 38306	2022-12-09	Dongle not at	t	
Point Cloud Colorizing					
🗉 Rigorous Data Adjustment ALS					No dongle attached
				~	

#### Notes

Import License file only once for each PC. You do not need to repeat the operation.

 Plug in the RiUNITE-1.0.3 Dongle. Copre will automatically convert rxp files to sdcx files when processing data during data processing.

>	> Data (D:) > @@2022-02-24-054121 > SCAN > Scanner1						
	~ 名称	修改日期	类型	大小			
ŀ	@@2022-02-24-054121.SP	2022/2/24 22:08	SP 文件	1 KB			
	220224_054540.rxp	2022/2/24 22:28	RXP 文件	23,358,448 KB			
	220224_054540.rxp.log	2022/3/31 16:39	文本文档	0 KB			
*	220224_054540.rxp.ripor	2022/3/31 17:04	JSON 文件	10 KB			
*	220224_054540.sdcx	2022/3/31 17:04	SDCX 文件	9,529,287 KB			
	220224_054540.sdcx.log	2022/3/31 17:04	文本文档	15 KB			
	AA2400-5-XC.EP	2021/11/17 16:09	EP 文件	1 KB			
	📄 RiUNITE_0.json	2022/3/31 16:39	JSON 文件	1 KB			

## 12.2 Laser data processing of AU900/AA1300/Alpha3D

#### Description

Add laser data processing function of AU900/AA1300/Alpha3D in CoPre 2 need to install thirdparty SW.

#### Step

 Prepare RiUNITE-1.0.3 software package, RiUNITE-1.0.3 software License, and RiUNITE 1.0.3 dongle.



Double-click SetupRiUNITE.exe to install with default Settings.



After the SW is successfully installed, open the LicenseCenter from the Start menu bar.







Click "Import...", import .lic file.

RIEGL License	eCenter 1.0	.1						-	_		$\times$
Licenses Ad	dditional	Messages									
Features and	licenses			Serial number	Valid until	Status	^		Import.		
🔝 Bathymet	try Tool Set								Add		7
Embedde	ed Kinemati	c LiDAR Data Acquisit	tion						Delete.		
Embedde	ed Kinemati	c LiDAR Data Acquisit	tion Light					⊠ She	w all :	feature	
Full Wave	form Analy	sis Batnymetry sis Topography									
Full Wave	form Analy	sis Topography with	GPU Support								
Import											×
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🧊 3D 对象		RiUNITE-1.0.3-in	nstall		2022/3/31 11:	20	文件夹				
🚪 视频		License_TianGIS	SN S2227161	_dongle 8306.lic	2021/10/28 1	5:56	LIC 文	件			1 KE
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Click "Save/apply changes now!".

censes Additional Messages				
eatures and licenses	Serial number	Valid until	Status 4	A Import
Bathymetry Tool Set Embedded Kinematic LiDAR Data Acquisition Embedded Kinematic LiDAR Data Acquisition Light Embedded Kinematic LiDAR Data Acquisition Light Full Waveform Analysis Topography Full Waveform Analysis Topography with GPU Suppor Georeferencing Georeferencing Kinematic LiDAR Data Acquisition Kinematic LiDAR Data Processing Kinematic LiDAR Data Processing Generatic LiDAR Data Processing Kinematic LiDAR Data Could Data Processing K	🚓 52227161	2022-12-09	Maintenance	Add Delete ⊘ Show all features
MTA Resolution MTA Resolution Point Cloud Colorizing Rigorous Data Adjustment ALS	306	2022-12-09	Dongle not at	No dongle attached



#### Notes

Import License file only once for each PC. You do not need to repeat the operation.

Plug in the RiUNITE-1.0.3 Dongle. Check the filter settings and choose MTA to process.

М.	Filter Settings	×
s	tatic Filter Settings	
	Static Data Filtering	
	Speed Limit (m/s)	0.010
		×
L	aser Filter Settings	
	Scanner1	
	Туре	Scanner_Riegl
	MTA Data	
	Field Angle Filtering	
	Field Angle(°)	360.0
	3D Distance Filtering (m)	
	Minimum	1.000
	Maximum	3000.000
	Intensity Filtering	
	Minimum	800
	Maximum	65535
	Height Distance Filtering (m)	
	Minimum	-99999.000 🗸
		OK Cancel

 CoPre will automatically convert rxp files to sdcx files when processing data during data processing.

> Data (D:) > @@2022-02-24-054121 > SCAN > Scanner1				
	~ 名称	修改日期	类型	大小
	🗋 @@2022-02-24-054121.SP	2022/2/24 22:08	SP 文件	1 KB
	220224_054540.rxp	2022/2/24 22:28	RXP 文件	23,358,448 KB
È	220224_054540.rxp.log	2022/3/31 16:39	文本文档	0 KB
	220224_054540.rxp.ripor	2022/3/31 17:04	JSON 文件	10 KB
	220224_054540.sdcx	2022/3/31 17:04	SDCX 文件	9,529,287 KB
	220224_054540.sdcx.log	2022/3/31 17:04	文本文档	15 KB
	AA2400-5-XC.EP	2021/11/17 16:09	EP 文件	1 KB
	RiUNITE_0.json	2022/3/31 16:39	JSON 文件	1 KB

## **13** Common problems and solutions

### CoPre 2 cannot display trajectory

**Reason**: The registration of the track view module fails or is not registered. It usually appears when CoPre 2 is installed with antivirus software.

### Solution:

1. Close the antivirus software and reinstall CoPre 2.

2. Open the installation directory of CoPre 2, find the regMapWinGIS.cmd file in the mapwingis folder, run it as an administrator, and then run regasm.bat in the installation directory as an administrator.

### The project raw path has changed

**Reason**: If the data is stored in the mobile hard disk for processing, if the computer is changed, the drive letter corresponding to the mobile hard disk may change, and the data path will also change, or the folder name and data path will also change when the computer is changed. When the task is loaded, the corresponding original data loading failure will be prompted. **Solution**: Re-import the original project.

### The task path is changed and cannot be loaded through historical tasks

**Reason**: The data is stored in the mobile hard disk, and the drive letters displayed on different computers are different, or the folder name is changed artificially.

### Solution:

Method1: Manually select the task file (\*.cpr) by opening the task.

Method2: Do not open the software through the shortcut, directly double-click the task file (\*.cpr), and the software will display the double-clicked task.

### Add missing data

**Reason**: The original data is missing when importing the data, so I want to add the missing data.

**Solution**: Put the new data into the corresponding directory of the project and refresh the project.

### The project files between multiple tasks are merged into one task

**Reason**: The data wants to be placed under a task for superimposed display for comparison **Solution**: By importing the preprocessing project (\*.solve), it can be merged into a certain task (the original project can also be imported directly). At this time, task 1 will contain the projects under task 2/task 3/task n. (Note: The merging here is not the merging of file paths in the true sense, but the file index is changed, so if the path of task 2 / task 3 / task n is changed after the merging, you still need to re-import Pre-process the project to task.

### The calibration parameters and the equipment do not match

**Reason**: The calibration parameters in SCAN/Scanner1 or IMG/Camera1 in the project directory do not match the equipment.

**Solution**: Contact CHCNAV support team to check.

### Process pictures and show error: Ladybug SDK error, operation failed.

**Reason**: It may be that the original file path of ladybug has Chinese symbols, or the file is damaged.

**Solution**: First check whether the pgr path of the original ladybug stream file has a Chinese path, if not, copy it from the device again.

# Process point cloud and show error: Riegl SDK error, unknown sub package V3.6 error. Reason: The original laser .rxp file is damaged.

**Solution**: Re-copy the original laser data from the device to rule out whether it was damaged during the data copying process. If this error is reported after the re-copying, it may be that the collected data is faulty.

### Import .csv format GCP file wrong.

**Reason**: The format of the control point of the .csv file is wrong.

**Solution**: Because some of the wrong format of .csv cannot be viewed through excel table, you can copy the content in .csv to .txt text for viewing, check the format of the control point, and re-import the control point after confirming that there is no problem.

## 14 Parameter settings

This chapter describes the Settings of CoPre parameters and recommended Settings.

## 14.1 POS accuracy curve



### Float/Fixed Ambiguity:

**Float:** When using carrier phase observations for localization, ambiguity is generated, which is an integer theoretically. After solving the integer ambiguity by the algorithm, the localization accuracy is substantially improved with a value is below 3.

**Fixed:** Sometimes the solution without solving an integer has a value is between 3 and 5. The

precision of the fixed solution is greater than that of the float solution.





**Quality Factor:** The quality factor of POS solution is determined according to the fuzziness fixation and the estimation accuracy, the range is 1-7 and the smaller the better, the value less than or equal to 2 is better.



**DOP:** The position accuracy factor, which reflects the satellite distribution, the range is 0.5-99 and the smaller the better, the value less than 3 is better.





**Estimated Position:** The information of the accuracy within the filtered solution can reflect the error size of each position to a certain extent, and the smaller the value the higher the accuracy.



**Estimated Attitude:** The information of the internal conforming accuracy of the filtering solution can reflect the error distribution of each attitude angle to some extent.





**Combined Separation:** It represents the position difference value between forward and reverse solution. The forward and reverse positions are related to many factors and are more difficult to quantify. The accuracy of the vehicle point cloud is required to be within 10cm, and if the forward and reverse positions are more than 30cm, it can be considered that there may be anomalies.



**Attitude Separation:** Represents the attitude difference value between forward and reverse solution, related to inertial guidance accuracy, forward and reverse attitude should generally be in fractions of an arcmin, if greater than 3 arcmin must be abnormal.


Calculated Satellites: how many satellites involving solving POS.

**Tips:** The combined separation and attitude separation do not really reflect the error size, and if the forward and reverse error is large, the probability of the solution result is anomalous

## 14.2 POS Optimize

#### Introduction:

When project is going on, it's possible that POS on vehicle jumps at parking place. It leads to points cloud distortion, so users are able to use POS Optimize function to smooth and repair POS to further solve distortion.

😽 Modify POS	×
Check Parameter	
Smoothing Distance (m): 20.00	
Check Threshold (m): 0.03	3
Repair Parameters	
Convergence Interval (m): 0.010	3
Time	
Add Delete	
2 1552358461.2,1552358558.145	1
1552358932.105,1552358987.59	
1552359465.41,1552359494.61	
1552359958.41,1552360044.965	
Check Agair Repair Cancel	

#### **Parameters Description:**

**Smooth Distance:** Extending distance at the jump to smooth.

**Check Threshold:** Any POS jump higher than this threshold would be repair, the minimum value is 0.01m.

**Convergence Interval:** Determinate 0.01m as default, it represents allowed jump after POS optimize, which will be less than this Convergence Interval.

**Time:** POS jump range could be selected by time. The default range is detected by Algorithm. **Check Again:** The first check is automatic, users are able to modify all parameters and check again. The blue area on the main display is jump range.

**Repair:** Select time range on the column to repair the POS, figure below is before and after comparison.



### 14.3 Filter Settings

### 14.3.1 【MTA Data】

In measurements using the pulsed time-of-flight principle, there exists a theoretical maximum range of distance measurement which is determined by laser emission frequency and the light speed. Before the echo signal generated by the previous pulse has returned, the next pulse signal has been sent. So that the receiver cannot determine echo signal from which pulse signal has returned, leading to uncertainty in the measurement, which is known as Multi-Time-Around (MTA) echo.

After receiving the echo pulse, MTA algorithm in CoPre automatically calculates the real distance to the target based on the echo patterns. The multi-time-around algorithm determines the maximum number of multi-periods that can be supported according to the detection capability at different point frequencies.

The following figure shows the point clouds of AU20 laser without multi-time-around solution (left) and after multi-time-around solution (right)



#### Tips:

(1) AA1400/AA2400/VZ2000i: Convert rxp to sdcx and must insert RiUNITE 1.0.3 dongle.

(2) AU900/AA1300/Alpha3D: Check the MTA, then insert the RiUNITE 1.0.3 dongle and convert rxp to sdcx. If do not check the MTA, also no need inserts the RiUNITE 1.0.3 dongle and conversion.

## 14.3.2 【Circle Noise Filter】

Туре	Scanner_LT	
MTA Data		
Circle Noise Filter	Low	*

The Circle Noise Filter is not selected as default, users are able to use it when noise still after MTA Filter. There are 4 options: Close, Low, Medium, High.

Low Option and Medium Option are used on most of noise occasions caused by Aerosols.

There would be slight noise in points cloud on plain ground, these points can be filtered by High selection.



Figures below are comparison between medium and high filter at edge.



#### Tips:

- (1) For sparse and edge area, high filter will delete useful points.
- (2) The parameters aim to AU20 device.

### 14.3.3 [Mapping Unresolved Targets]

Mapping Unresolved Targets for AA1400 data, mainly for power line data.







### 14.3.4 **[**FOV Filtering**]**

#### Algorithm Principle:

Filter point clouds outside the FOV range.

As shown in the figure below: the red range is the field of view  $90^{\circ}$  area, the green range is the field of view  $120^{\circ}$  area, if the field angle is set to  $90^{\circ}$ , the points outside the red range will be filtered out; if the field angle is set to  $120^{\circ}$ , the points outside the green range will be filtered out.

#### Algorithm Schematic:



#### **Actual Performance:**

Туре	Scanner_Livox
FOV Filter	$\checkmark$
FOV(°)	60.000

This setting is only valid for airborne radar data, the default value of AA450 is  $60^{\circ}$ , AU20 is  $360^{\circ}$ , and other devices is  $120^{\circ}$ . The larger the field angle, the larger the point cloud range. The following figure shows the left set the field angle to  $120^{\circ}$ , the right set the field angle to  $60^{\circ}$ 



### 14.3.5 【3D Distance Filtering】

#### Algorithm Principle:

Determining the 3D distance minimum and maximum threshold will filter out points that are not within range of the scanner's 3D distance. The 3D distance filtering origin is the center of the laser and value is positive downwards.

#### Algorithm Schematic:



#### **Actual Performance:**

3D Distance Filtering is a default Selection, could be modified as individual lidar device type.

3D Distance Filtering (	
Minimum	1.000
Maximum	100.000

### 14.3.6 [Intensity Filtering]

#### Algorithm Principle:

Filter out point clouds that are not within the setting range according to the grayscale value. The parameter values can be modified as needed, with different default parameter values for different laser types.

General point clouds with anomalous reflectivity can be filtered by intensity filtering.

#### **Actual Performance:**

Intensity Filtering	$\checkmark$
Minimum	1
Maximum	65535

## 14.3.7 【Height Distance Filtering】

#### Algorithm Principle:

Filter out point clouds that are not in the elevation filtering range. The elevation filtering origin is the laser center, positive upwards.

#### Algorithm Schematic:



#### **Data Actual Performance**

Height Distance Filteri	
Minimum	-99999.000
Maximum	99999.000

By measuring the noise point above 100m from the point cloud, the range of the maximum value can be set to [-100, -1] according to the flight height of 100m.





**Tips:** Height Distance Filter is mainly determined according to the noise height and the distance between laser and noise.

### 14.3.8 [Noise Filtering]

#### Algorithm Principle:

Within the cover radius, if the neighbor points number is less than 5, the algorithm will filter this noise. As shown in the figure below: the number of neighbor points within the radius d of the yellow point is 1; there is no neighbor point within the radius d of the green point, so these two points will be filtered out, and the red point within the radius d has 5 domain points, the point will not be filtered out.

#### **Algorithm Schematic:**



#### **Actual Performance**

Noise Filtering (m)	
Noise Distance Thre	1



If the jumping noise filter distance threshold is set to 1m, it means that the point is within a sphere with a radius of 1m. If the number of neighboring points is less than 5, the point will be filtered out. The following figure shows the comparison before and after setting the jumping noise.



Tips:

Generally, flying spots can be filtered by jumping noise. If the point cloud is relatively sparse, you need to increase the threshold appropriately. It is recommended to determine it larger than the maximum point intervals, otherwise useful points will be filtered out.

### **14.4 Coloring Parameters**

Coloring 0~65535 🔹 🗹 Remove Unshaded Points 🔲 Filter Tower Shadow				
Trigger Filter Interval (m):10.000Cover Radius (m):8.500				
Mask File: 2023-03-22-083721/AUTOSOLVE/Camera1/Picture/MaskImage.jpg				
Scanner Nar	Scanner Name Scanner1			
Camera Name Camera1				

#### **Coloring Parameters Description:**

**RGB Information Range:** The default ranges 0~65535, or 0~255. color range determines information storing space and abundance.

Remove unshaded points: Delete points which are not colored.



**Filter Tower Shade:** Default selection, it solve the problem that the tower color is assigned to the ground when the power line data is colored (the option of the vehicle data is disabled), the comparison diagram is as follows:



**Trigger Filter Interval:** This setting is only valid for MMS vehicle data, and the default value is 10m. When the on-board point cloud coloring is blocked by the front or rear of the car, this parameter can be appropriately increased.

**Cover Radius:** This data is only valid for vehicle-mounted data. The default determination is 8.5m. When the MMS point cloud coloring is blocked by the front or rear of the vehicle, this parameter can be appropriately increased.

**Mask:** Mask Tool works on MMS vehicle data; users are able to use it to make mask based on a panoramic picture. Press Shift+Left Click to draw a mask.







Drawing Illustration



Camera Selection It's possible to select individual camera to colorize the point clouds.

Scanner Name	Scanner1	]
Camera Name	Camera1	
Generate Result Re	Camera1 eport	Ī
Output Directory:	G:/ProblemData/Andrei450 10Adjust/AdjustTask/Results	

## CHCNAV

## 14.5 Refine

Refine function allows selecting pioneer point next to GCP to refine point clouds to improve absolute accuracy.

### 14.5.1 [Mode 1: Refine POS(position only)]

#### **Algorithm Principle:**

This function refines position information in POS file, mainly applied on MMS vehicle data. **Algorithm Schematic** 



#### **Actual Performance**

Model1: Refine pos(refine position only)
 Distance Threshold (m): 500.00 
 Smooth Threshold (m): 50.00

#### Correction Mode 1 Parameter Description

The distance threshold is set to 500m by default, and the smoothing threshold is set to 50m by default. That is, when the distance between GCP is less than 500m, the position error value of POS is calculated according to the error of adjacent GCP. When the distance between GCP is bigger than 500m, it smooths the area in a 50m radius neighbor range of GCP.





## 14.5.2 [Mode 2: Refine POS(position and attitude)]

#### Algorithm Principle:

This function refines position and attitude information in POS file. It embeds GCP coordinates to solve POS along with attitude from INS, and position from GNSS. It applies on strip MMS vehicle data.

#### **Algorithm Schematic**



### 14.5.3 [Mode 3: Refine Points Cloud (Based On near control point

### error)

#### Algorithm Principle:

Sampling neighbor GCP errors to correct points. It applies to polygon plain area or urban area with enough GCP. Need to determine smooth distance. The outward expansion distance of the GCP convex hull boundary line, from the GCP convex hull boundary line to the outward expansion boundary line gradually tends to 0. The default value is 50 meters, that is, the boundary line of the GCP is expanded by 50m, and the boundary line from the boundary line of the GCP to the 50-meter boundary line that is expanded gradually tends to 0. If the error of the GCP is large, the value can be appropriately adjusted to make the correction amount of the expanded point cloud transition smoothly.

#### Algorithm Schematic:



#### **Actual Performance:**



```
Model3: Refine pointcloud(base on near controlPoint error) —
Smooth Distance (m): 50.00 <sup>(2)</sup>
```

### 14.5.4 [Mode 4: Refine Points Cloud (Point Cloud Overall Offset)]

#### Algorithm Principle:

The overall rotation offset of the point cloud is applicable to the scene where there is a relative position offset between the GCP and the point cloud. When using this algorithm, try to ensure that the GCP cover the survey area and are evenly distributed.

#### Algorithm Schematic:



#### **Actual Performance:**

Before correction, the GCP is 100cm away from the point cloud. After Mode 4, the GCP is on the point cloud. The figure below is the comparison before and after Mode 4.





## 14.6 Adjust

When the point clouds between different airways are layered, the error between point clouds can be eliminated through adjustment. According to the data type, the adjustment can be divided into airborne adjustment and vehicle-mounted adjustment.

### 14.6.1 【Adjust airborne data】

😽 Adjust		×
Project Name	Adjustment Data	Trajectory File
@@2023-04-05-AU10_powerline	/Scanner1	20230405_132406506.Pos
< Block Size(m): 100.00 Change Position O Change At	📰 Grid Size(n titude 🔵 Change	n): 0.30 $\ddagger$ Position And Attitude OK Cancel

#### **Parameters Description:**

#### Block Size:

The airborne adjustment divides the point cloud into blocks according to the block size, the unit is m, and the default value is 100, that is, the point cloud is divided into 100\*100 point

clouds according to the plane position. The larger the value, the fewer block point clouds, the faster the adjustment efficiency, and the worse the adjustment effect; the smaller the value, the more block point clouds, the slower the adjustment efficiency, and the better the adjustment effect. Maximum setting is 150m.

**Grid Size:** It is a resampling size, this parameter is used for point cloud thinning, the unit is m, the default value is 0.3, that is, all points in every 0.3m cube are thinned to 1. The larger the value, the more the number of thinned point clouds, the faster the adjustment efficiency, and the worse the adjustment effect; Low. Maximum setting is 1m.

Adjustment mode: there are 3 modes: change position, change attitude, change position and attitude. Attitude adjustment only is selected by default in the airborne adjustment parameter interface. When the error between flight strips is small, you can select only attitude adjustment mode, which has high efficiency and the effect can meet the requirements; when the error between flight strips is large, It is recommended to select the adjustment position and attitude, and the adjustment effect is good. It is not recommended to select only the adjustment position mode for airborne adjustment.

### 14.6.2 [Adjust vehicle-mounted data]

	🗸 Adjust			×
	Project Name	Adjustment Data	Trajectory File	Data Correctness
	@@2022-09-06-122041	/Scanner1	20221128_223753330_correct.Posl	ОК
	Block Time Interval(s):	[5.00 🍦 G	rid Size(m): 0.30	Smooth Time(s): 5.00 🍦
	O channe Brailting O cl	hanna Attituda 🔍 Channa		-lasted Time America
Ľ		hange Attitude 🔘 Change		

#### **Parameters Description:**

**Block Time Interval:** MMS divides the point cloud into blocks according to the set interval, the unit is s, and the default value is 5s, that is, the original point cloud will be divided into pieces of point cloud data according to 5s. The larger the value, the fewer block point clouds, the faster the adjustment efficiency, and the worse the adjustment effect; the smaller the value, the more block point clouds, the slower the adjustment efficiency, and the better the adjustment effect.

**Adjustment mode:** It includes 3 selections: change position, change attitude, change position and attitude three modes. The vehicle-mounted adjustment parameter interface defaults to the adjustment position and attitude. The adjustment effect is good, but the efficiency is slow.



The vehicle-mounted adjustment can also be selected to only adjust the position. The efficiency is high, but the effect is worse than the adjusted position and attitude. It is not recommended to use the vehicle Adjustment Select the adjustment attitude mode only.

**Smooth Time:** The unit is s. According to the smoothing time, the point cloud at the beginning and end of the time period is selected for smooth transition, so as to ensure that there are no faults in the point cloud of the adjustment part and the edge part of the point cloud that has not been adjusted.

**Selection Range:** When checked, only adjust the point cloud within the time range of the selected trajectory. It can be applied on batch projects.

### 14.7 Reconstruction

### 14.7.1 【AT】

📲 AT	×
Scene City	
POS Accurancy Plane Accuracy(m): 0.050 THeight Accuracy(m):	0.050 🗍
OK	Cancel

#### **Parameters Description:**

**Scene:** Select the scene according to the data type. The scene is divided into three types: town, mountain and plain. The number of connection points extracted by the software is different when the scene type is different.

**POS Accuracy:** Set the accuracy of plane and elevation when solving, the default is 0.05.

## 14.7.2 【DOM】

📲 DOM	×			
Data Source				
Mode Settings         High Efficiency         It can quickly generate results, and the effects of buildings, water areas and so on in the results are general.         High Quality         It takes a long time to output good and high-quality results.				
Scene Settings				
POS Accurancy Plane Accuracy: 0.050 <sup>+</sup> Height Accuracy: 0.050 <sup>+</sup>				
DOM Settings Adaptive Resolution Custom Resolution (m): 0.05				
Output Path:       G:/ProblemData/Andrei450_10Adjust/AdjustTask/Results         OK       Cancel	el			

#### **Parameters Description:**

**Data Source:** Select according to the corresponding data, where the laser data source is only optional in the high-efficiency mode, and the image data source is mandatory.

**Mode Setting:** Contains two modes of high efficiency and high quality. High efficiency generates orthographic speed quickly, but the effect is poor. High quality generates orthographic speed slowly, but the effect is better.

**Scene:** Contains 3 scenes of town, mountain and plain, select according to the actual data scene type.

**POS Accuracy:** The allowed range of accuracy.

**DOM Setting:** Select Adaptive Resolution, the software will automatically calculate the resolution of the orthophoto, if select Custom Resolution, the software will output the orthophoto according to the set resolution;

In general, CoPre can export three different DOM results, depends on used data source and process modes:

**Result 1:** Select both Lidar and image as the data source, and the default is only the highefficiency mode, which can get a quick DOM result.

**Result 2**: Select image only as the data source and use high-efficiency mode. This way can also quickly generate a quick DOM result, but the quality is relatively poor, and it is only suitable for non-urban areas.

**Result 3**: Select the image as the data source and use high-quality mode. This way need finish AT first then do can final DOM processing, so the output effect is good, and the quality is high, but it takes longer time.



Mode	1	2	3
Data Source	Points Cloud & Images	Images	Images
Solving Mode	Efficiency	Quality	Quality
Time	Medium	Short	Long
Scenarios	All	Non-Urban	All
Shortage	Need point cloud data.	Quality of texture is not good	Quality of Water and vegetation is not good

Tips:

Generate DOM based on AT is mode 3 above.

## 14.7.3 【3D Modeling】

👫 Model	×				
Data Source	Image				
Mode Settings High Efficiency High Quality	Quickly generate result, but the effect of building & water area is relative poor. Generate high quality result, but the processing time is longer.				
Process Mode Single Mode Cluster Mode Settings					
Tile Adaptive Tile Size Custom Tile Size (m): 100.00 Confirm Predicted memory usage: 0.0 GB.					
Output DOM					
Output Path:     D:/CopreWorkSpace/AA450 SampleData/Results					
	OK Cancel				

#### Parameters Description:

Data Source: Select data according to project. LiDAR data is optional.

**Mode Setting:** Mode Setting includes high-efficiency and high-quality modes, the highefficiency generation model is fast, but the effect is poor, and the high-quality generation

model is slow, and the effect is better.

Process Mode: Supports two processing modes.

Single Mode: Modeling on 1 PC;

Cluster Mode: Modeling on multiple PCs within a local area network.

**Tile:** There are two options: Adaptive Tile Size and Custom Tile Size. If use Adaptive Tile Size, CoPre will automatically calculate the appropriate tile size according to the remaining memory of the computer; If use Custom Tile Size, user need configure a custom value then click Confirm button, and CoPre will automatically calculate a predicted memory usage based on tile size. Note, the estimated memory usage should be less than 60% of the computer memory.

**Output DOM:** It will output DOM simultaneously with model.

#### Tips:

There are 2 modeling methods at AT node like below:

Method	Method 1	Method 2	
Data Source	Points Could & Images	Images	
Mode	Efficient	Quality	
Time Cost	less	more	
Scene	All Scene		
Shortage	Distortion on water and vegetation		
Advantage	Efficient	Higher Completeness	

## **CHC** Navigation

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