DJI TERRA

Operation Guide

V3.6 2023.02

Updated on: February 2023

Applicable version: This document was drafted based on DJI Terra V3.6.0. Operations of other software versions may be different. Please ensure the software is at least V3.6.0.

Document description: This document only briefly describes certain key functions and is not a product manual. For functions not mentioned in this document, please download the user manual from the DJI Terra official website to find out more:
https://www.dji.com/downloads/products/dji-terra

Change Log

Version	Date	Revision
v1.0	February 2022	First version created
v2.0	August 2022	1. Replaced operation screenshots with version 3.5.0. 2. Modified GCP import method to version 3.5.0. 3. Added description for Seven-parameter calculation. 4. Added description for Vertical Datum import. 5. Added description for Light Uniformity/Haze Reduction of 2D orthophotos. 6. Added description for 3D Reconstruction: ROI/Block Splitting function. 7. Added description for Custom Model Origin function. 8. Added description for Merged Output function. 9. Modified description for error prompts.
v3.6	February 2023	1. Added description for third-party cameras compatible with Visible Light Reconstruction. 2. Added description for Smooth Point Cloud function. 3. Added the LiDAR Point Cloud Accuracy Check function. 4. Added the Detailed Inspection function supported by Matrice 30 and Mavic 3 Enterprise series. 5. Modified description for Light Uniformity/Haze Reduction function. 6. Modified description for Distance to Ground/Subject in Reconstruction Settings.

Table of Contents

Introduction to DJI Terra

Product Overview

DJI Terra is a PC application developed by SZ DJI Technology Co., Ltd. and it focuses on 2D Orthography and 3D Model Reconstruction while supporting functions such as 2D Visible Light Reconstruction, LiDAR Point Cloud Processing, and Detailed Inspection. It is a one-stop solution that helps enterprises fully enhance their operational efficiency, providing a complete suite of reconstruction features for verticals such as surveying, power generation, emergency rescue, construction, transportation, and agriculture.

Product Highlights

1. **High processing efficiency:** DJI Terra's standalone reconstruction processing speed is 3-5 times that of other mainstream software. For cluster reconstruction the processing efficiency increases several fold.
2. **Excellent reconstruction quality:** Superb modeling that can recreate minute structures from close-up photography data. High reconstruction accuracy down to the centimeter level without ground control points.
3. **Large throughput** 64G RAM enables processing of up to 25,000 photos for standalone reconstruction and 400,000 photos for cluster reconstruction.
4. **Supports cluster reconstruction:** 2D and 3D reconstruction support parallel processing of all PC network clusters within a local area network, increasing efficiency by multiple times.
5. **Easy to operate:** Operation is easy without complex parameter settings. Easily accessible by beginners.

Configuration Requirements

The data-processing computer must be installed with an NVIDIA graphics card and Windows 7 or higher, while meeting the following hardware specifications:

Configuration Requirements	2D/3D/Real-time 3D Reconstruction	LiDAR Point Cloud Processing	Real-time 2D
CPU	I5 or higher		
GPU	Use of an NVIDIA graphics card with computing power* of 3.0 or above is recommended.		No requirements
RAM	32GB or higher		8GB or higher
VRAM	4GB or higher		No requirements
HDD & SSD	At least 200GB idle memory usage		

* Computing power is a key metric of a graphics card's performance. The computing power of NVIDIA graphics cards can be found on their official website. Typically, a mid to high-spec graphics card should have computing power of 3.0 or above: https://developer.nvidia.com/cuda-gpus#compute

The table below shows how RAM size determines the maximum photo processing quantity for 2D and 3D reconstruction:

RAM	Standalone Computation	Cluster Computation
	Max Processing Quantity (Photos)	Max Processing Quantity (Photos)
32GB	12,800	192,000
48GB	19,200	288,000
64GB	25,600	384,000
128GB	51,200	768,000

* RAM refers to the available RAM of the DJI Terra software (available RAM = total RAM - RAM used by the system and other software). Before reconstruction, you may check the remaining RAM by accessing Windows Task Manager.
* Maximum photo processing quantity is unrelated to the resolution of a single image. That means the maximum processing quantities for P1 and P4R are the same.
* The RAM for cluster computation refers to the available RAM of the control device.

The table below shows how RAM determines the maximum data size for LiDAR point cloud processing:

RAM	Max Raw Point Cloud Size
16GB	4GB
32GB	8GB
64GB	16GB
128GB	32GB

* Raw point cloud size shall be calculated based on the total LDR file size in the imported file, and is not affected by the JPG format of any photo.
* If the RAM is too small, you may split a big project into multiple tasks to be processed, then merge the multiple LAS files using third-party point cloud analysis software.
* LiDAR point cloud processing only supports standalone computation and not cluster computation.

Software Version

DJI Terra comes in four versions: Agriculture, Pro, Electricity, and Cluster. The paid features supported by each version are shown below. Note that cluster computation is only supported by the Cluster version. The same software is used by all the versions. The availability of paid features on each version is determined by their respective license.

Terra License Plans

Feature/Version	Agriculture	Pro	Electricity	Cluster
Real-time 2D Mapping	✓	✓	✓	✓
Agricultural application	✓	✓	✓	✓
2D Reconstruction (Field)	✓	✓	✓	✓
2D Multispectral Reconstruction	✓	✓	✓	✓
2D Reconstruction (Urban)	–	✓	✓	✓
KML file import	–	✓	✓	✓
Output Coordinate System	–	✓	✓	✓
ROI Reconstruction	–	✓	✓	✓
Image POS import	–	✓	✓	✓
Multi-GPU Reconstruction	–	✓	✓	✓
3D Reconstruction	–	✓	✓	✓
3D Mission planning	–	✓	✓	✓
Real-time 3D Mapping	–	✓	✓	✓
GCPs	–	✓	✓	✓
LiDAR Point Cloud Accuracy Optimization	–	✓	✓	✓
LiDAR Point Cloud Smoothing	–	✓	✓	✓
Electricity Application	–	–	✓	✓
Detailed Inspection	–	–	✓	✓
Cluster Computation	–	–	–	✓
Bind Device	3 devices	1 device	1 device	3 nodes
Authorization mode[13]	Online	Online/Offline	Online	Offline
Validity Period	1 year	1 Year/Permanent[14](Free update for the first year, paid update from the next year)	1 year	Permanent[14](Free update for the first year, paid update from the next year)
How to Buy?	Buy Now	Buy Now	Buy Now	Contact Us

Reminders for First Use

There are two types of product licenses for DJI Terra: online and offline. For online licenses, paid features can only be used if the license is verified on the computer once every 3 days. Offline licenses cater to scenarios requiring greater information security, where paid features are available even when the equipment is offline (the device used for modeling does not need to be connected to the internet, as long as an online computer is used to generate the license). Online licenses can be activated at https://license.dji.com/, while offline licenses can be activated at https://terra-license.djiservice.org/.

For details relating to software installation, offline license activation and other relevant matters, please refer to the "For First-time Users" and "Guidelines for DJI Terra Offline License" chapters in "Preparation Before Using DJI Terra", available on the DJI Terra official website.

Download Links

The latest software and manual as well as past software versions can be downloaded from the DJI Terra official website:
https://www.dji.com/cn/dji-terra?site=brandsite&from=nav

Visible Light Reconstruction

Function Overview

Visible light reconstruction includes 2D and 3D reconstruction. In 2D reconstruction, Digital Surface Models (DSM) and Digital Orthophoto Maps (DOM) of an area are generated using images captured by a drone, based on the principles of photogrammetry; while 3D reconstruction relies on photogrammetry, multiple view geometry in computer vision, and computer graphics to generate a 3D model of a scene using drone-captured images.

You may obtain high-precision 2D maps or 3D models through the visible light reconstruction feature, for a wide range of uses including topographical mapping, engineering survey and maintenance, geological disaster investigation, fire and disaster rescue, national land survey, urban planning, cultural heritage conservation, and crop protection.

The basic workflow of 2D reconstruction is as follows: Import data -> Aerotriangulation -> 2D reconstruction

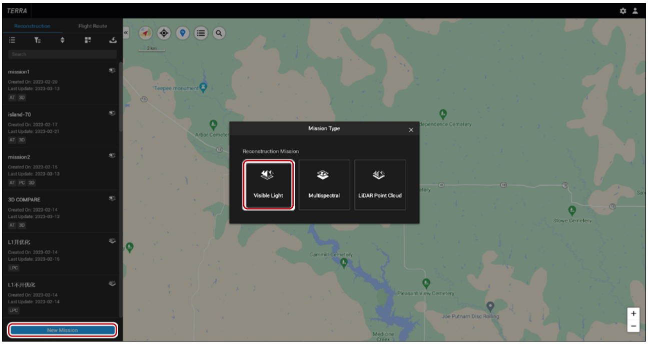
The basic workflow of 3D reconstruction is as follows: Import data -> Aerotriangulation -> 3D reconstruction

Aerotriangulation is an essential step in 2D and 3D reconstruction. It can be done separately or together with 2D or 3D reconstruction. The detailed data processing process is as follows:

Importing Data

Create Reconstruction Mission

Open and log into DJI Terra, click “New Mission” in the lower left corner and select “Visible Light” mission type.



Add Photos

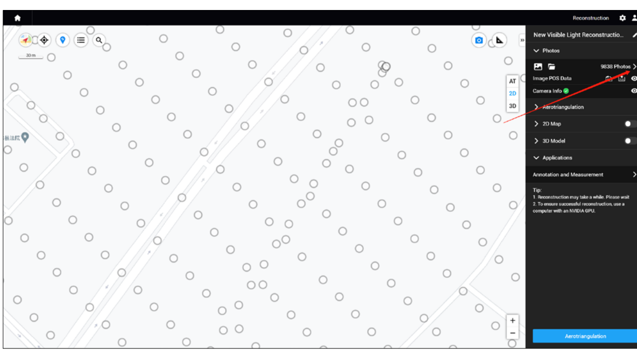
1. Add raw images through either of the following methods:
   Click , then select photos to add from the computer. You may press “Ctrl + A” to select all photos to import.
   Click , then select the folder in which the desired photos are located. If there are sub-folders, all images in them will be added automatically.
   Note that the folder path name must not include special characters, such as #. Otherwise, the mark view on the GCP page cannot be displayed.

2. Camera POS Display

After adding images, the (camera icon) icon will appear on the top right corner of the map. The location corresponding to each photo will be displayed as a round dot on the 2D map.

3. Photo Management

Click > on the right of an image to manage photos. The photos are displayed in groups according to their folder. Expand the list of each group to check and manage photos.



4. Select Photos for Designated Area

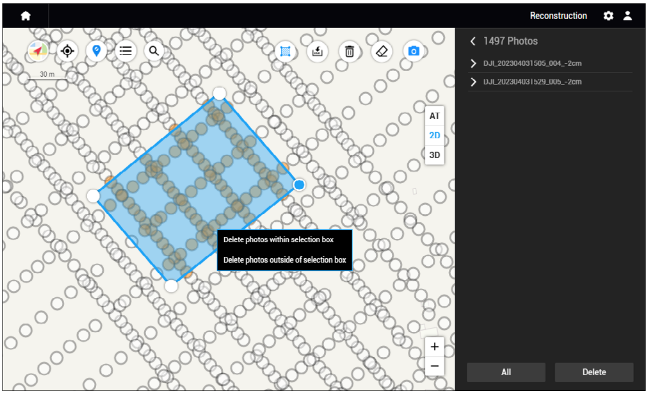
To retain or remove photos from a designated area, perform the following on the photo management interface:

a. Add boundary points

Click the (icon) icon, then use the left button of your mouse to add boundary points on the map to drag-select an area. If you have previously set a KML area, you may click the (KML icon) icon to import the KML file, and the points contained in the file will become boundary points forming a drag-selected area.

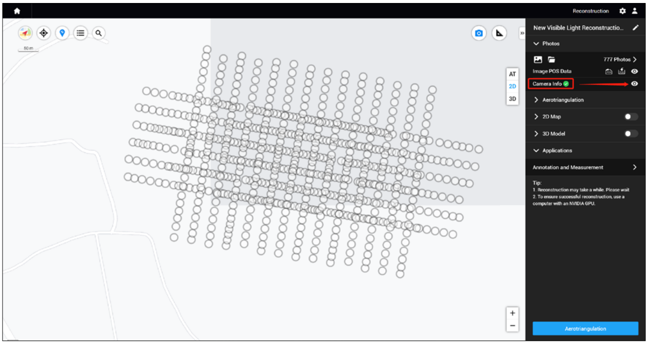
b. Edit Boundary Points
   Click and select a boundary point with the left button of your mouse, press and drag the left button to adjust the position of the boundary point, and click on a boundary to insert a new boundary point. Click 🗑 to remove the current selected boundary point, and click ⌫ to remove all boundary points.

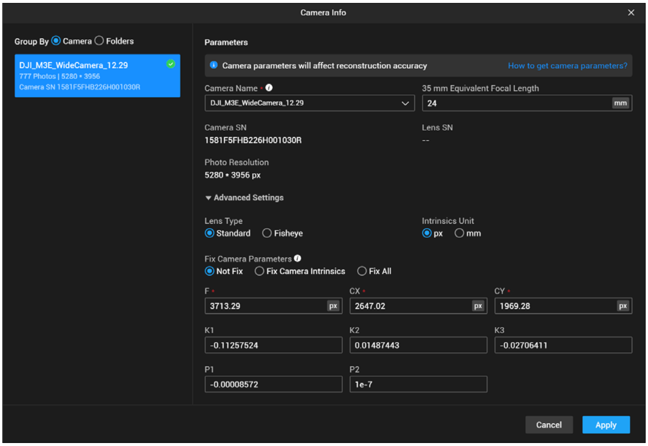
c. After selecting an area, press the right button of your mouse. In the pop-up menu, select photos to remove from within or outside the designated area.



Thereafter, click < to return to the reconstruction page.

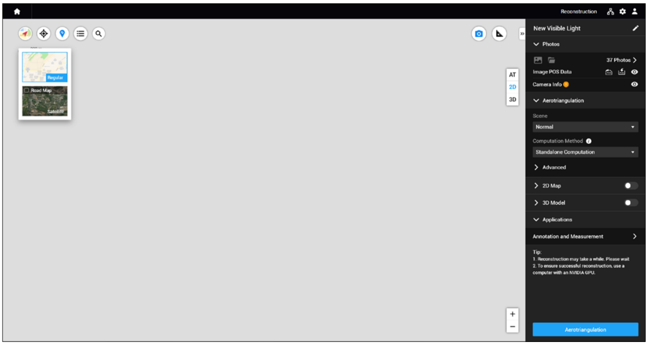
5. View Camera Information
   If the imported photos were captured by a DJI Enterprise drone with a third-party camera that is compatible with DJI Terra, a green check mark will appear which indicates that the camera information is complete and includes all details such as the focal length and the principal point. Click on the “eye” icon to check the camera details:



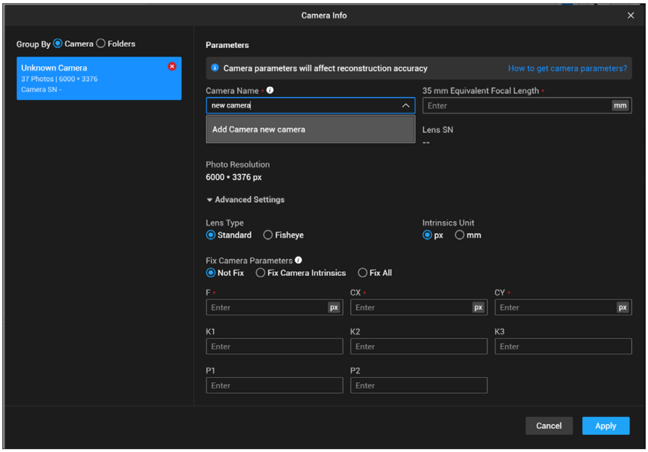


6. Input Camera Information

If the imported photos were not captured by a DJI Enterprise drone or with a camera that is compatible with DJI Terra, then a yellow exclamation mark will appear next to "Camera information". When this happens, processing the data directly will result in accuracy loss and even aerotriangulation errors. In this situation, click the "eye" icon to input the camera details manually.



If you are using a single-lens camera, then input the relevant information directly on the “Camera Type” page. After entering the name of your camera, press the Enter key and then input a 35mm equivalent focal length.



This will greatly increase the aerotriangulation accuracy. To achieve greater accuracy, we recommend clicking "Advanced Settings" then enter these parameters: F, CX, CY, K1, K2, K3, K4, P1, and P2.

Camera parameter details are usually provided in full by their manufacturers. If the F value is not provided by a manufacturer, an approximate value can be calculated using the following formula:

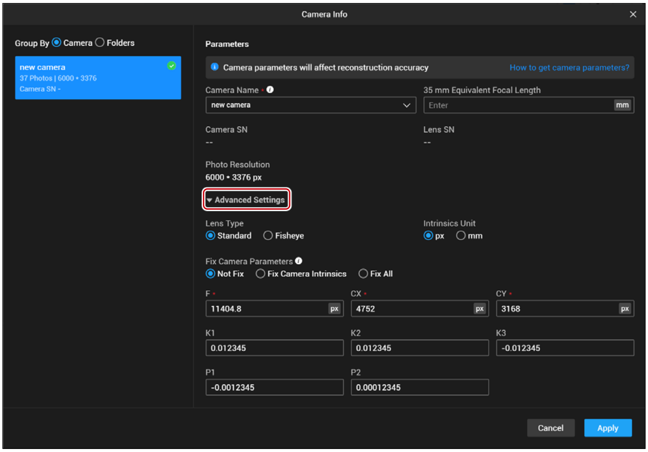
F = (Focal Length/Sensor Size) x Width or F = Physical Focal Length (mm) / Pixel Size (μm)

This formula is for reference only. Please follow parameters provided by the camera manufacturer.


```xml
<?xml version="1.0" encoding="utf-8"?>
<OpticalProperties version="1.0">
    <Id>0</Id>
    <Name>A</Name>
    <Description/>
    <Directory/>
    <ImageDimensions>
        <Width>6000</Width>
        <Height>4000</Height>
    </ImageDimensions>
    <CameraModelType>Perspective</CameraModelType>
    <CameraModelBand>Visible</CameraModelBand>
    <SensorSize>22</SensorSize>
    <FocalLength>40.12345678</FocalLength>
    <Distortion>
        <K1>0.0123456</K1>
        <K2>0.0123456</K2>
        <K3>-0.123456</K3>
        <P1>-0.00123456</P1>
        <P2>0.000123456</P2>
        <Direct>true</Direct>
    </Distortion>
    <PrincipalPoint>
        <X>3000</X>
        <Y>2000</Y>
    </PrincipalPoint>
    <AspectRatio>1</AspectRatio>
    <Skew>0</Skew>
    <Exif/>
</OpticalProperties>
```


Example of a camera parameters file from a camera manufacturer (the data shown are not real)

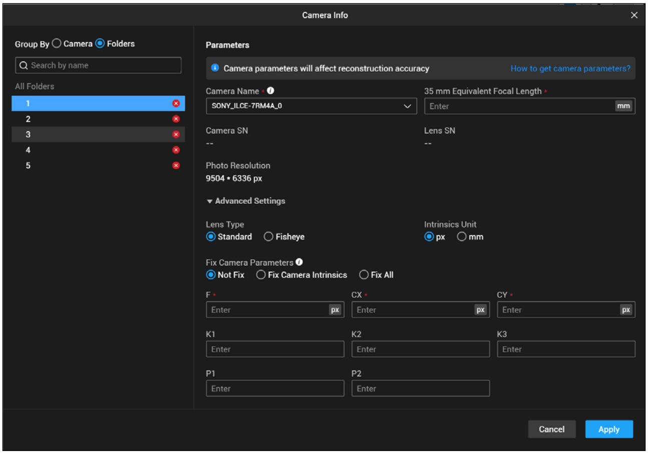
Fill in the information based on the above camera details as follows:

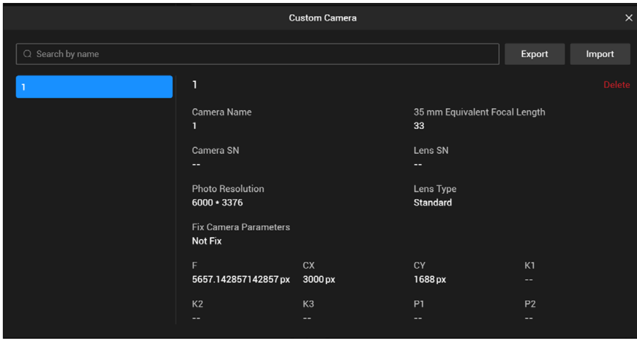


If the imported photos were captured by multiple cameras, such as a five-lens oblique camera, the photos shot by each camera should be saved in separate folders. Do not save data from different cameras into the same folder. Select “Folder” and input the parameters of each camera separately.

After entering the details of the camera/each camera, click Apply to save them. Expand the “Camera Name” list to select and use any of the saved camera details.

By clicking the exclamation mark button on the right of “Camera Name”, then clicking "View "and expanding the camera details list, you can import or export any camera details already saved in the list, for use with other camera details in DJI Terra.





To ensure information accuracy, we recommend that you first enter the initial camera details provided by the manufacturer, then perform an aerotriangulation computation using DJI Terra and export the aerotriangulation information. Thereafter, update the camera details according to the optimized parameters in the aerotriangulation report. Using these intrinsic parameters will yield better modeling results.

Below is a screenshot of part of the camera parameters from an aerotriangulation report. F value represents the focal length.

Camera Calibration Information

Camera Model M3E_WideCamera

Camera SN 1581F5FHB226H001030R

Item	Focal Length	Cx	Cy	K1	K2	K3	P1	P2
Initial	3713.29	2647.02	1969.28	-0.11257524	0.01487443	-0.02706411	-0.00008572	0.00000010

Block0

Item	Focal Length	Cx	Cy	K1	K2	K3	P1	P2
Optimized	3720.59	2644.59	1975.34	-0.10684349	0.00182291	-0.02052354	-0.00001028	-0.00063966

Import Image POS Data

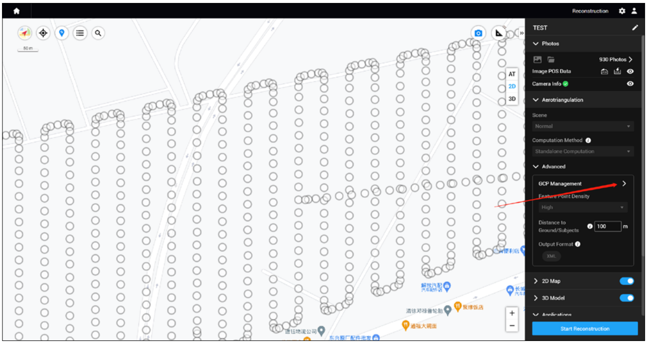
Image POS data record the geographical location, attitude and other positioning details of a photo. Accurate POS data can help improve reconstruction speed and output accuracy. The POS of some third-party cameras are separate from their images, and needs to be imported through an additional step. This step is not required for data captured by a DJI drone and payload (such as Phantom 4 RTK and Zenmuse P1), as their POS will be written into the photos.
Certain third-party cameras do not write POS into their images, in which case you may use the import image POS function to match the photos with their POS. If output based on the local coordinate system is required, you can use a coordinate conversion tool to convert raw image POS into local coordinate POS, then import it. The steps are as follows:

1. Prepare a POS data file (shown below) according to the import format requirements for image POS data. DJI Terra supports the import of data in TXT and CSV format. The data must at least contain the image name (an absolute path with a .jpg suffix), latitude (X/E), longitude (Y/N), altitude (Z/U), and euler angle. For .txt files, the comma (,), period (.), semicolon (;), space, and tab can be used as a separator. Please ensure the image name in POS corresponds uniquely to the imported image data name.

⚠ To convert the coordinates of the intrinsic POS data of an image, click "Export POS Data" on the right of "Image POS Data" to export the POS, convert it using a third-party coordinate conversion tool (such as Coord), then import it back.

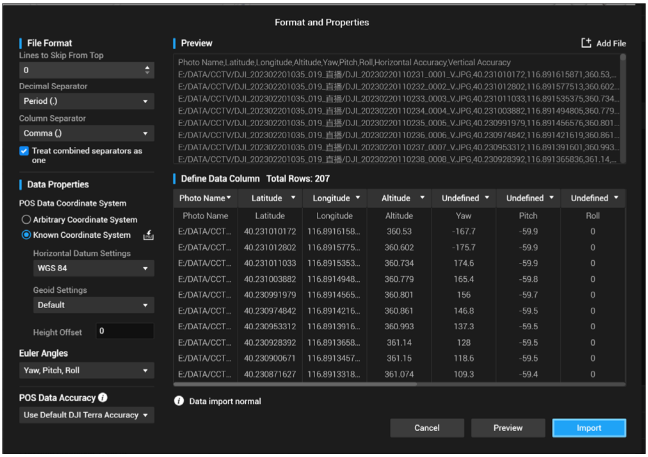
	A	B	C	D	E	F	G	H	I	J
1	Photo Name	Latitude	Longitude	Altitude	Yaw	Pitch	Roll	Horizontal	Vertical Accuracy	
2	E:/DATA/CCTV	40.23101	116.8916	360.53	-167.7	-59.9	0	2	10	
3	E:/DATA/CCTV	40.23101	116.8916	360.602	-175.7	-59.9	0	2	10	
4	E:/DATA/CCTV	40.23101	116.8915	360.734	174.6	-59.9	0	2	10	
5	E:/DATA/CCTV	40.231	116.8915	360.779	165.4	-59.8	0	2	10	
6	E:/DATA/CCTV	40.23099	116.8915	360.801	156	-59.7	0	2	10	
7	E:/DATA/CCTV	40.23097	116.8914	360.861	146.8	-59.5	0	2	10	
8	E:/DATA/CCTV	40.23095	116.8914	360.993	137.3	-59.5	0	2	10	
9	E:/DATA/CCTV	40.23093	116.8914	361.14	128	-59.5	0	2	10	
10	E:/DATA/CCTV	40.2309	116.8913	361.15	118.6	-59.5	0	2	10	

2. Click "Import POS Data" on the right of "Image POS Data", then select the POS data file you wish to import. Note that if the photos do not contain POS, the software page will still not display any POS point even after POS has been imported. However, the imported POS data will be used during reconstruction. If the photos have intrinsic POS, the original data will be overwritten by any new imported and converted POS.



3. In "File Format", click the import data format and set "Lines to Skip from Top", "Decimal Separator", and "Column Separator".

The “Define Data Column” window will display data based on your settings in “File Format”. “Lines to Skip from Top” is for deleting the titles and sample lines of the data file.
“Decimal Separator” allows you to define how decimal points should be displayed (which varies between countries).
With “Column Separator”, you can set the separator to be used between the columns in the file.



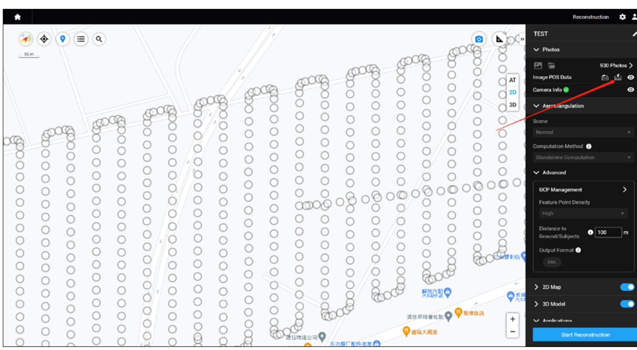
4. In “Data Properties”, set “POS Data Coordinate System” and “Geoid Settings”. For a special coordinate system, you may select an arbitrary coordinate system. For an elevation system that does not exist in the system, you may select “Default” (ellipsoidal height) in “Geoid Settings”.
5. With “Height offset”, the overall height can be increased or reduced. Vertical irregularity between ellipsoidal height and altitude in a small scope can be treated as a constant value. By setting this parameter, you can enable quick adjustment of ellipsoidal height to altitude.
6. In “Euler angle”, you may select the image attitude details. The details supported by DJI Terra are Yaw, Pitch, Roll and those in the Omega, Phi, and Kappa format. If attitude information is not applicable, you may select “None”.
7. “POS Data Accuracy” enables you to set the accuracy of your image POS data. If you opt for DJI Terra’s default accuracy, the software will determine based on the photos’ XMP information whether each photo was captured in RTK status. If so, the default horizontal and vertical accuracy shall be 0.03 m and 0.06 m respectively; otherwise they shall be 2 m and 10 m respectively. If you are using a third-party camera or importing PPK post-differential results, define a custom accuracy and set the accuracy options for each data column.
8. In “Define Data Column”, you can select the corresponding item for each data column, then click “Import” at the bottom to import the POS data.

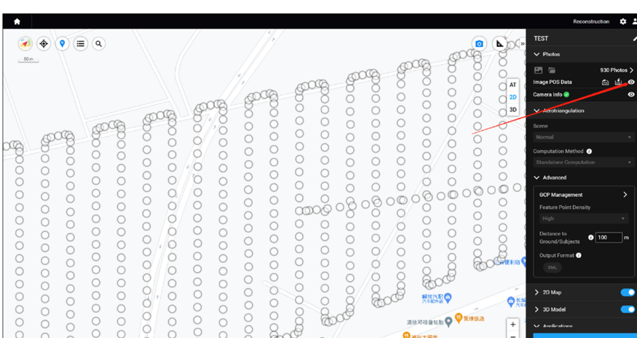
Define Data Column Total Rows: 25

Undefined	Undefined	Undefined	Undefined	Undefined	Undefined	Undefined
Name	Latitude	Longtitude	Altitude	Yaw	Pitch	Roll
100_0001_171...	31.75678992	123.103553535	23.13423423	-179.9633456	-89.476576546	0
100_0001_172...	31.75689223	123.103689989	23.36525445	-179.9663678	-89.637746546	0
100_0001_173...	31.75646378	123.103469989	23.26243534	-179.9645676	-89.987976789	0
100_0001_174...	31.75711232	123.103359979	23.56464565	-179.9879788	-89.768798546	0
100_0001_175...	31.75699889	123.103345346	23.67648356	-179.5789868	-89.786586465	0
100_0001_176...	31.75677782	123.103398979	23.13443545	-179.9885777	-89.989605456	0
100_0001_177...	31.75669682	123.103422424	23.89876454	-179.9898599	-89.786965764	0

⚠
- Photo name, latitude (X/E), longitude (Y/N), and altitude (Z/U) are required.
- You cannot select the same definition for multiple columns.

9. After import is completed, click “View POS Data” on the right of “Image POS Data” to check whether the POS data has been imported properly.





10. After confirming the import was successful, proceed to the next step.
    For the POS import function, you may also refer to the tutorial video "DJI Terra - Image POS Data Import"

Using the PPK Result Files

Phantom 4 RTK

For Phantom 4 RTK, the Cloud PPK service on the remote control app can be used to perform PPK computation. For details on the PPK service, you may refer to the "Cloud PPK Service" chapter in "Phantom 4 RTK - User Manual". DJI Terra can automatically identify cloud PPK computation results.

Follow these steps:

1. Copy the file of the cloud PPK computation results on your Phantom 4 RTK (named "result.csv") into the image folder.
2. Create a mission and add the photos.
3. The POS data in the PPK result file will be automatically imported into the software with the photos. Click icon on the right of "Image POS Data" to view and edit the POS data in the PPK result file.
4. If you wish to use the POS data included in the photos for reconstruction, remove the PPK result file from the image folder before adding photos.

Zenmuse P1 or Other Third-Party Payload

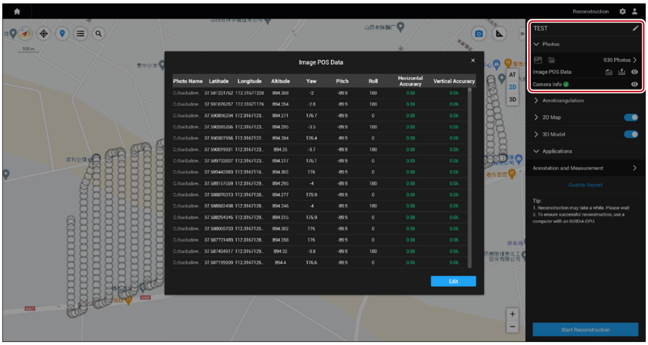
For Zenmuse P1 or other third-party payload, a third-party PPK computation software may be used to perform the computation. After obtaining the output, you can then import them in the same manner as in the previous section, "Import image POS Data".

After PPK computation is complete, if the image solutions are fixed, you may set the horizontal and vertical POS accuracy to 0.03 m and 0.06 m respectively, which can enhance processing efficiency and accuracy substantially. If the solutions are not fixed, the horizontal and vertical accuracy can be set to 2 m and 10 m respectively.

The PPK files for M300's PSDK have not been made open-source, therefore any third-party PSDK payload mounted on M300 is unable to use the PPK function. Zenmuse P1 will save the satellite observation source file required for PPK post-processing. You may use third-party software to perform PPK post-differentiation on P1. For details, please refer to "Zenmuse P1 - User Manual".

Aerotriangulation

Aerotriangulation refers to the photogrammetric process of computing the camera's attitude at the time of image formation and the spare point cloud of the target based on the spatial and geometric correlation between the image point and the target. After aerotriangulation, you can quickly determine whether the quality of the raw data meets the project delivery requirements and whether any image needs to be added or removed. Aerotriangulation is required prior to both 2D and 3D reconstruction.



Aerotriangulation Parameter Settings

1. **Scenarios**

   Different computation methods apply to different scenarios. You may choose a suitable scenario according to your shooting method. Explanation for different options:
   Normal: Applicable to most scenarios, including oblique photography and orthophotography.
   Circle: Applicable to circling scenarios and especially for reconstructions of small and vertical objects, such as base stations, towers, and wind-driven generators.
   Power Lines: Applicable only to visible-light cameras (such as a Phantom 4 RTK) when shooting power lines in a vertical zigzag manner.

2. **Computation Method**

   If the computer has permission for cluster computation, you can choose either standalone or cluster computation here (for details on cluster computation, please refer to Chapter 4 "Cluster Reconstruction"). If the computer only has permission for standalone computation, no "Computation Method" options will be available.

3. **Advanced Settings**

   a. Feature Point Density

      High: More feature points are extracted in single images. Suitable for scenarios requiring higher output accuracy and more refined effects.
      Low: Fewer feature points are extracted in single images. Suitable for scenarios requiring faster output.

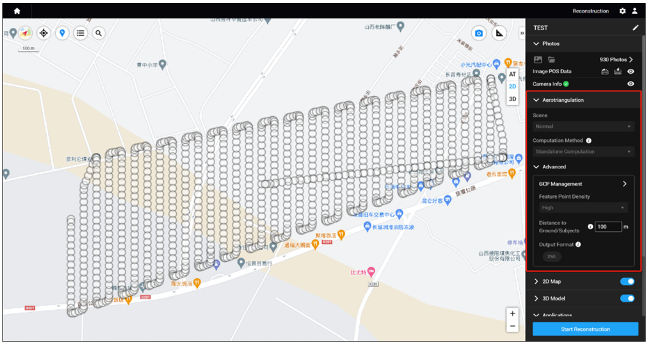
b. Distance to Ground/Subject

This refers to the distance between the camera and the subject while capturing data. If multiple distances exist, the shortest one will be applied. This parameter guides aerotriangulation block splitting. The greater the distance to ground/subject, the slower the aerotriangulation computation.

c. XML Format

You may choose to output in XML format, namely with “ContextCapture” and “Blocks Exchange”. For the coordinate system, we recommend keeping it consistent with that for 2D and 3D reconstruction. Most model editing software requires this file.

⚠ XML files only support projected coordinate systems and not geographic coordinate systems.



Ground Control Points (GCPs)

GCPs are ground marking points with distinctive features and geographical coordinates that are clearly identifiable on an image. The geographical coordinates of a GCP can be obtained through measuring technology such as GPS, RTK, or with an electronic total station. Then link the GCP with the image where it was captured, by marking the GCP using software. GCPs are divided into control points and check points. Control points are used for optimizing aerotriangulation accuracy and increasing modeling precision, as well as conversion into a local coordinate system or the 85 elevation system. Check points are used for checking and evaluating aerotriangulation accuracy in a quantitative manner.

When conducting 2D or 3D reconstruction, you can import GCPs after adding images, to enhance the aerotriangulation accuracy and robustness, check the accuracy, and convert the aerotriangulation results into the designated GCP coordinate system, so as to increase the accuracy of the reconstruction output.

Layout of GCPs

1. Preparing GCP Files

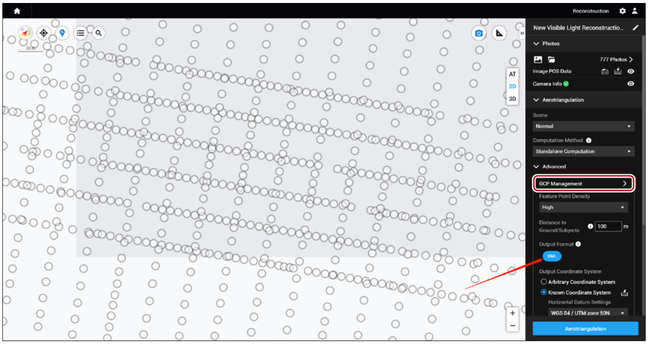
a. Before using the GCP function, prepare a GCP file which must contain the following information: the GCP name, latitude (X/E), longitude (Y/N), altitude (Z/U), horizontal accuracy (optional), and vertical accuracy (optional). Each item must be separated by a space or separator. Note that for a projected GCP, "X" refers to the easting value which is typically a 6 or 8-figure number (with a zone number); while "Y" refers to the northing value which is typically a 7-figure number. Be sure not to confuse "X" and "Y".

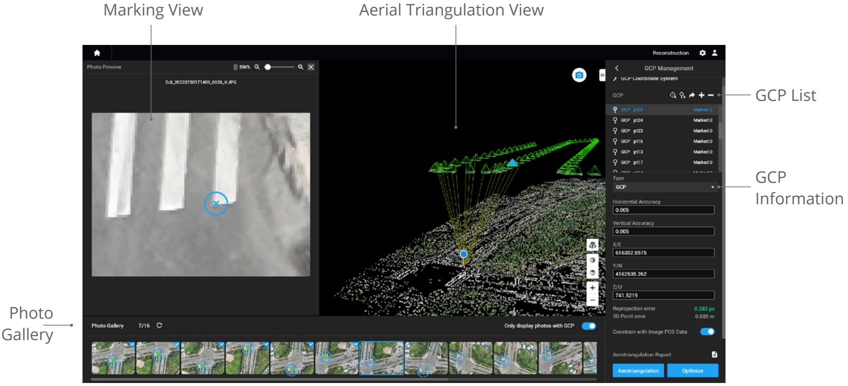
Name	Latitude	Longitude	Altitude
1	35.[illegible]9	116.[illegible]9	37.745
2	35.[illegible]4	116.[illegible]2	36.805
3	35.[illegible]5	116.[illegible]6	38.477
4	35.[illegible]7	116.[illegible]6	38.914
5	35.[illegible]6	116.[illegible]9	40.322
6	35.[illegible]3	116.[illegible]8	40.726

Name	X	Y	H
1	48[illegible].8	392[illegible]4	42.[illegible]2
2	48[illegible].9	392[illegible]3	41.[illegible]8
3	48[illegible].6	392[illegible]1	43.[illegible]5
4	48[illegible].5	392[illegible]9	43.[illegible]6
5	48[illegible].5	392[illegible]0	45.[illegible]6
6	48[illegible].6	392[illegible]1	45.[illegible]2

GCPs expressed in latitudes and longitudes (left table), and in a projected coordinate system (right table)

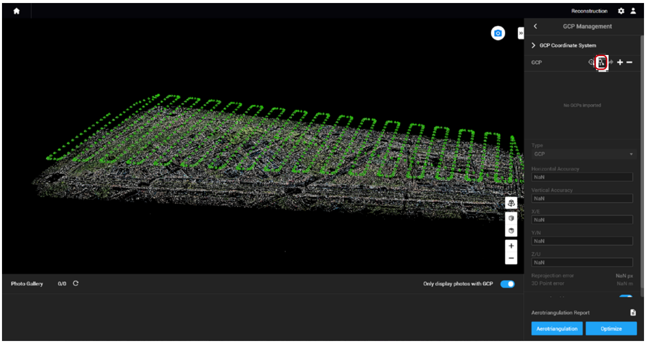
b. Click "GCP Management" to enter the GCP management page, which includes the GCP list, GCP information, photo gallery, aerial triangulation view, and marking view. After an image is selected in the photo gallery, its marking view will appear on the left of the aerial triangulation view, as shown below. You may add GCPs and mark points on this page to perform aerotriangulation computation and optimization.





2. Importing GCPs

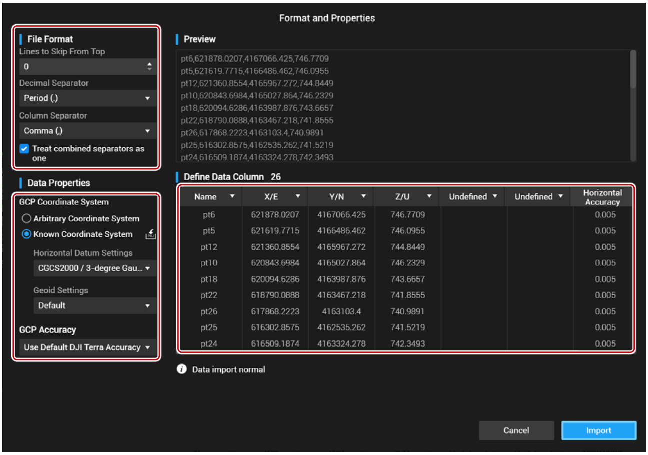
a. On the GCP list, click “Import GCP File” to import a GCP file.



b. After the GCP is imported, define the file format first. If the first line is not coordinate information such as data format description, the first line should be skipped; then set the decimal separator, where care should be taken to differentiate between "." which is used by most countriesand "," as used by some; finally, define the column separator, which can be a comma (,), space ( ), semicolon (;), and tab; if there are multiple separators, you may select "Treat combined separators as one" to separate the items correctly.

c. After defining the data format, select the GCP coordinate system and elevation system. If the POS altitude uses the ellipsoidal height and the GCP altitude uses the National Vertical Datum 1985, or the GCP uses a local coordinate system, then "arbitrary coordinate system" should be selected.

d. Lastly, in "Define Data Column", expand the menu to set the definitions corresponding to each data column, then click "Import".



e. If you are marking a GCP with other equipment, you may export the entire mark file then click "Import mark file" to import the mark file in JSON format.

3. Editing GCPs

a. If you need to add or delete a GCP, click "+" or "-" on the GCP list. Press and hold the "Ctrl" button to select multiple GCPs, and press and hold the "Shift" button to select all GCPs between two mouse clicks.

b. Select a point in the GCP list to edit its GCP information at the bottom. If you are setting a GCP as control point or check point, edit the horizontal accuracy, vertical accuracy, and set the coordinate values matching the GCP coordinate system.

c. Before marking the points, click the "Aerotriangulation" button first to perform aerotriangulation processing on the image. After this is completed, the aerotriangulation computation results will appear on the left, including the camera's POS and point cloud.

4. Marking Optimization

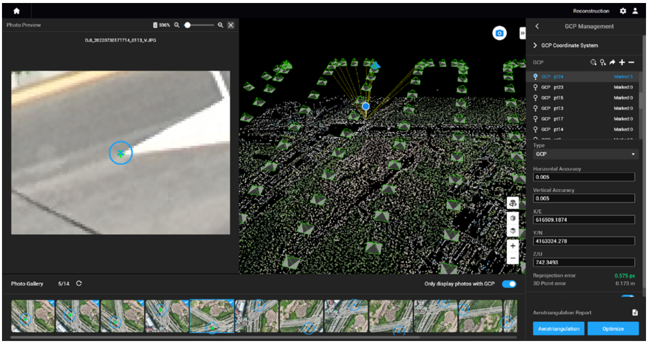
Marking is the process of linking the geographical coordinates of a GCP collected on the field with the photo where this point is seen. Whether it is a control point or check point, marking is required in order for it to take effect.

a. Before marking a point, we recommend clicking the “Aerotriangulation” button first to perform aerotriangualtion on the photo. After this is completed, the estimated location of the GCP will be more accurate. You may skip aerotriangulation and mark a point directly. However, the estimated GCP location may be inaccurate, with more time needed to locate the point.

   For a special coordinate system, the marking process is as follows: aerotriangulation — import GCP file — adjust the coordinate system as “arbitrary coordinate system” — mark the point — disable “Constrain with Image POS Data” — optimize.

   For a known coordinate system and where the elevation system is consistent to when the drone was collecting the data, the marking process is as follows: aerotriangulation — import GCP file — select “Known Coordinate System” as the GCP coordinate system — mark the point — leave “Constrain with Image POS Data” enabled — optimize.

b. Select any GCP and enable “Only display photos with GCP” on the right of the photo gallery. Click an image in the photo gallery that contains this GCP, and its marking view will appear on the left. The blue crosshairs above it indicates the estimated location of the selected GCP’s projection onto this image.

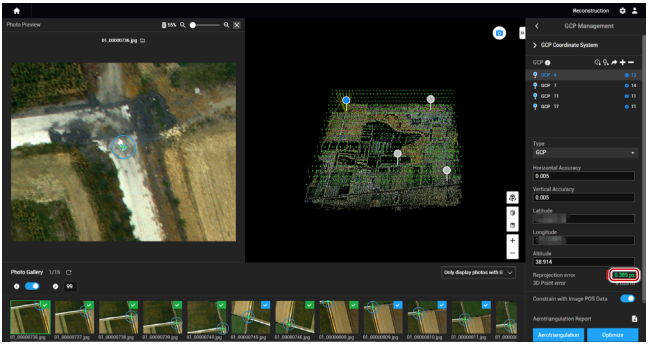


c. On the marking view, press and hold the left button of your mouse to drag the image, and roll the scroll wheel to zoom in and out of the image. Click the image and use the crosshairs to mark the GCP’s actual location on the image. The mark is displayed as a green cross on the marking view and photo gallery thumbnail. Meanwhile, a check mark will appear on the top right corner of the thumbnail to indicate it is a mark.

d. Click the “Delete” icon above the marking view to delete the mark information on the image.

e. For a GCP, after marking of the third image is completed, the estimated location of the blue crosshairs will be updated in real time according to changes of the mark location. “Reprojection error” and “3D point error” below the GCP information will also be updated.

f. “Reprojection error” and “3D point error” can be used to determine errors in mark accuracy and raw POS accuracy. Depending on the error size, the color of the number will change to green, yellow, or red. If the error suddenly becomes larger after the marking of a photo, please check if the wrong location has been marked. For an area, we recommend using at least five evenly distributed control points, with at least eight mark images for each control point (for data from five lenses, it is preferable to have at least five mark images for each lens). Scatter the image locations as much as possible, and keep the mark locations away from the edge of the images. If the estimated location of a newly added photo basically matches its actual location, the GCP does not require marking.



g. If “Constrain with Image POS Data” is enabled, the horizontal and vertical accuracy in the initial POS of an RTK image become 0.03 m and 0.06 m respectively. Together with the GCP, this initial POS will constrain aerotriangulation.

- If the POS and GCP are under the same coordinate system and elevation system, we recommend enabling this button as it will greatly increase reconstruction efficiency and accuracy.
- If the GCP is under a local coordinate system or National Vertical Datum 1985, we recommend selecting “arbitrary coordinate system” for the GCP coordinate system and disabling the “Constrain with Image POS Data” button.
- If you are using a local coordinate system, have created a PRJ file for a local coordinate system, and are defining the GCP’s coordinate system using an imported PRJ, we recommend disabling the “Constrain with Image POS Data” button.

h. After completing the marking of all GCPs, click the “Optimize” button to perform aerotriangulation computation. Thereafter, an aerotriangulation report will be generated, and the aerotriangulation area on the left will also be updated as the optimized results. An aerotriangulation report focuses on errors in control points or check points as well as the overall error. If an error is too large, the accuracy fails to meet the requirements. In this case, you will need to re-mark the point with a greater error or increase the GCP count.

GCP Information Overview

Check Point

Name	dx (m)	dy (m)	dz (m)
pt26	0.007319	-0.067114	-0.016460
pt25	-0.029767	0.037104	-0.040305
pt24	-0.036836	-0.034594	0.001198

Check Point RMSE

dx (m)	dy (m)	dz (m)
0.027668	0.048572	0.025145

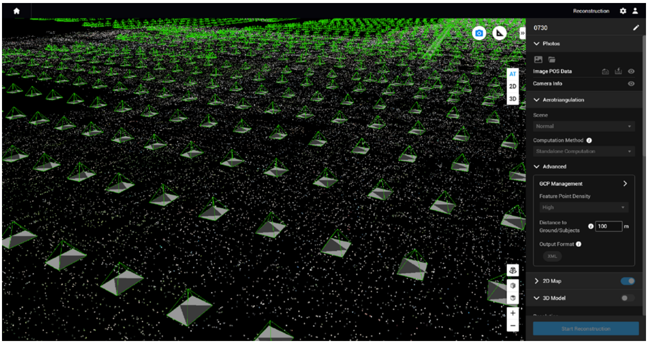
i. By selecting a GCP, you can view the post-optimization reprojection and 3D point errors in the GCP information at the bottom. You can also view details of the control point/check point errors highlighted in the aerotriangulation report.

j. Click the “Export GCP” button to export control point and mark information as a JSON file for use in other missions.

k. After ensuring the accuracy is correct, return to the mission home page to perform the next step.

DJI Terra supports data processing without GCPs as well as skipping the GCP marking step, where you may click “Aerotriangulation” directly and wait for the aerotriangulation process to complete, then click “Quality Report” to view the output quality.

For the relevant GCP functions, you may also refer to the tutorial video: “DJI Terra - GCP Management”.



Quality Report for Aerotriangulation

DJI Terra Quality Report for Aerotriangulation

Parameters

Parameters	Value
Feature Point Density	High
Cluster Computation	No

Image Information Overview

Item	Value
Number of Images	9838
Image with Camera POS	9838
Calibrated Image	9623
Constrain with Image POS Data	Yes
Georeferencing RMSE	0.039 m
Connected Components	1
Max Components Images	9623
Aerotriangulation Time	1h 36.027min

RTK Status

Status	Number of Images
Fix	9838
Floating	0
Single	0
Other	0

Camera Calibration Information

Camera Model M3E

Camera SN 493OJC98AA01K8

Item	Focal Length	Cx	Cy	K1	K2	K3	P1	P2
Initial	3715.82	2647.60	1956.78	-0.10944050	0.00572781	-0.02109762	-0.00008949	-0.00022433

Block0

Item	Focal Length	Cx	Cy	K1	K2	K3	P1	P2
Optimized	3715.32	2647.56	1957.45	-0.10876412	0.00486709	-0.02094354	-0.00008978	-0.00020876

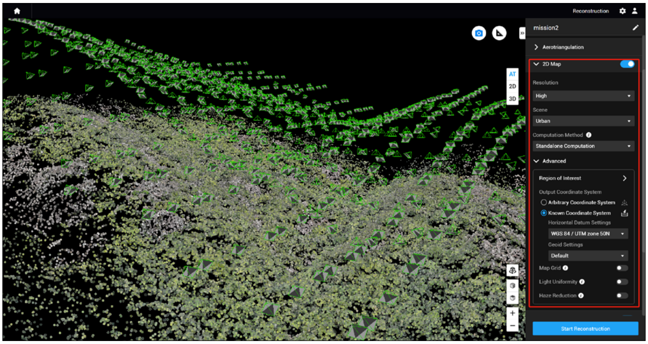
Covariance Matrix

	Error	Focal Length	Cx	Cy	K1	K2	K3	P1	P2
Focal Length	0.01066071	1.00000000	-0.00196491	-0.07690325	-0.24478234	0.21533761	-0.19540033	0.00367676	0.00004793
Cx	0.00463072	-0.00217145	1.00000000	-0.00058484	-0.00024890	0.00029427	-0.00038849	-0.00002324	-0.08261995
Cy	0.00410850	-0.03509138	-0.00133110	1.00000000	0.00048007	-0.00041855	0.00068846	-0.07563428	0.00005101
K1	0.00000618	-0.32991539	0.00717138	0.00374554	1.00000000	-0.97241503	0.92029964	-0.00918004	0.00372430
K2	0.00001555	0.22091078	-0.01018940	0.00727142	-0.97296642	1.00000000	-0.98417679	0.00970908	-0.00448995
K3	0.00001150	-0.22666095	0.01264873	-0.00855561	0.92058421	-0.98392318	1.00000000	-0.01338171	0.00640310
P1	0.00000019	0.02897717	0.00153754	0.57016414	-0.00735377	0.00780440	-0.01072573	1.00000000	0.00246092
P2	0.00000019	0.00662303	0.71776445	-0.00508701	0.00200278	-0.00274636	0.00443605	0.00327586	1.00000000

An aerotriangulation quality report provides the following key parameters:

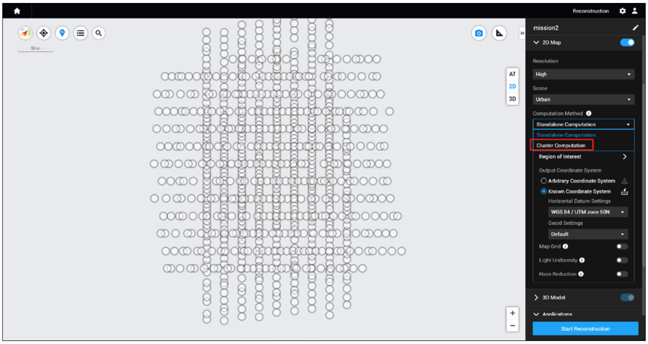
1. Calibrated images: This refers to the number of images involved in the aerotriangulation computation. If the number of calibrated images is less than the images imported, it means some images could not be used for the computation, perhaps because certain areas captured were without texture or had little texture (such as bodies of water or snow-covered scenes); or the shooting angles and resolution for these areas shot differed too much from the other data. If output is incomplete due to such reasons, you may need to recapture shots on the field.
2. Georeferencing RMSE: This refers to the RMSE between the computed image location and the location recorded in the image. This parameter reflects the relative accuracy of the initial POS: the smaller its value, the higher the accuracy.
3. Image RTK status: For images with fixed solutions, the accuracy is set as centimeter-level. The more images with fixed solutions, the better (the accuracy for floating solutions and single solutions are set as decimeter and meter-level respectively; if there are no solutions, it means no RTK positioning computation was performed). If all the images have fixed solutions, this will ensure the accuracy without GCP under the POS coordinate system is at the centimeter level. If images with fixed solutions only account for a small portion, the absolute accuracy of the output will be poorer. You will need to add suitable GCPs to ensure a higher absolute accuracy.
4. Camera calibration information. This focuses on the comparison between the initial camera focal length/cx/cy and the camera focal length/cx/cy after aerotriangulation optimization. Generally, the difference before and after optimization does not exceed 50 pixels. If the difference is large, you may troubleshoot using the following method:
   a. If the focal length differs greatly before and after optimization, and the images used for reconstruction are facing the same direction (for instance, the photos are all orthographic or facing a building facade), then increase the number of photos shot from other angles (such as oblique photos);
   b. If the cx and cy differ greatly before and after optimization, check whether the sensor direction was changed when the images were collected (for instance, the aircraft turned its heading to collect data during a survey mission).

2D Reconstruction



Click the “2D Map” button and set the relevant parameters.

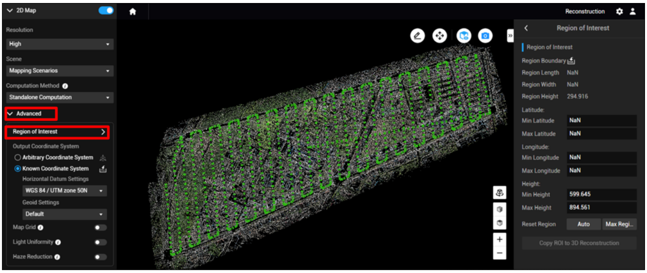
1. Setting the reconstruction resolution: “High” means the original resolution, “Medium” means 1/2 of the original resolution (i.e. the image length and width are 1/2 of the original), and “Low” means 1/3 of the original resolution (i.e. the image length and width are 1/3 of the original). For example: If the resolution of the original shots is 6000×6000, that would be the high resolution; the medium resolution would be 3000×3000 and the low resolution 2000×2000.
2. Selecting the mapping scene: Whether in the city or a village, “Urban” scene should always be selected for survey missions. “Field” and “Fruit Tree” scenes apply to DJI agricultural drones. For hilly terrain, reconstruction using “Field” and “Fruit Tree” settings may result in dislocation or distortion.
3. Selecting the computation method: If the computer has permission for cluster computation, you can choose either standalone or cluster computation to perform the computation. If the computer only has permission for standalone computation, no such options will be available. For the relevant settings for cluster reconstruction, please refer to the “Cluster Reconstruction” chapter.



Region of interest (ROI)

While performing 2D/3D reconstruction, you may select and model an ROI after adding photos. Generating models of only within an ROI saves time and increases efficiency.

Note that ROI modeling can only be done after aerotriangulation is completed. After finishing aerotriangulation, click "Region of interest" in Advanced Settings to enter the region of interest edit page.



1. **Defining an ROI:** You may define an ROI through the following four methods. The coordinate system used here is consistent with that in Output Coordinate System Settings.
   - Click "KML Import" to convert the dots in the KML file into boundary points of the ROI.
   - Input the min/max latitude, longitude and height or XYZ values of the ROI, then click Apply to set the ROI.
   - For the "Reset Region" setting, tap "Auto" or "Max Region" and the software will automatically generate the ROI. Auto: Automatically calculates an appropriate rectangular area based on the distribution of the aerotriangular point clouds. Max Region: A rectangular area that covers all the aerotriangular point clouds.
   - Tap at the top of the screen to enter editing mode, then tap on the relevant location on the map to manually add boundary points, and input the height value in the height text box to set the ROI.
2. **Translating an ROI:** Tap to enter Translation Mode and drag the defined ROI to translate it.
3. **Editing a ROI:** Tap to enter editing mode. Tap on the relevant location on the map to manually add boundary points. Drag the boundary points to adjust the location and the area shape. Select a boundary point then tap to remove it. Tap to remove all boundary points. Tap to exit editing mode.
4. **Other information and settings**
   a. When the region of interest is rectangular, its length, width, and height will be displayed at the top of the page.
   b. Camera location display: Display/hide the camera location for added photos.

c. Display zone: Display/hide the defined ROI.
d. If you are performing 2D and 3D reconstruction at the same time, clicking “Copy ROI to 3D Reconstruction” will copy the ROI into the 3D reconstruction mission.

Output coordinate system - Known coordinate system

During 2D and 3D reconstruction, you may set the output coordinate system after adding photos. If your photos do not contain POS data, the default coordinate system will be an "arbitrary coordinate system". If the added photos contain POS data, the default coordinate system for 2D reconstruction will be the UTM projected coordinate system for the mission's location. Note that when a GCP has been marked, the output coordinate system must be the same as that for the GCP, otherwise the output's coordinates will not match the GCP's.

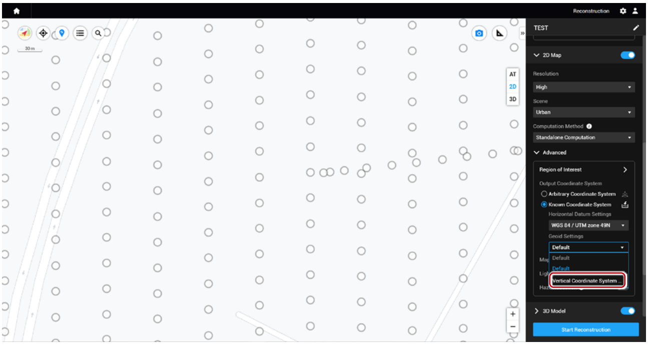
You may set a known coordinate system by either importing a PRJ file or searching for it in the DJI Terra coordinate system library.

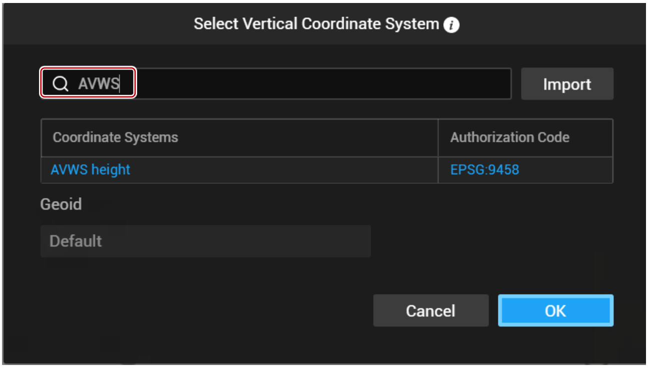
1. **Importing a PRJ file:** Search and download the .prj file for the desired coordinate system on the website https://spatialreference.org. Then click in DJI Terra to import. If it is a custom coordinate system, you may download another public PRJ file, then modify five parameters as follows: a - target coordinate system name; b - seven parameters; c - target ellipsoidal central meridian; d - target ellipsoidal east additive constant; e - target ellipsoidal north additive constant. For example:

```
PROJCS["Sample",
    GEOGCS["China Geodetic Coordinate System 2000",
        DATUM["China_2000",
            SPHEROID["CGCS2000",6378137,298.257222101,
                AUTHORITY["EPSG","1024"]],
                  TOWGS84[1,2,3,4,5,6,7],
            AUTHORITY["EPSG","1043"]],
        PRIMEM["Greenwich",0,
            AUTHORITY["EPSG","8901"]],
        UNIT["degree",0.0174532925199433,
            AUTHORITY["EPSG","9122"]],
        AUTHORITY["EPSG","4490"]],
    PROJECTION["Transverse_Mercator"],
    PARAMETER["latitude_of_origin",0],
    PARAMETER["central_meridian",120.666667],
    PARAMETER["scale_factor",1],
    PARAMETER["false_easting",300000],
    PARAMETER["false_northing",-3000000],
    UNIT["metre",1,
        AUTHORITY["EPSG","9001"]],
    AUTHORITY["EPSG","4549"]]
```

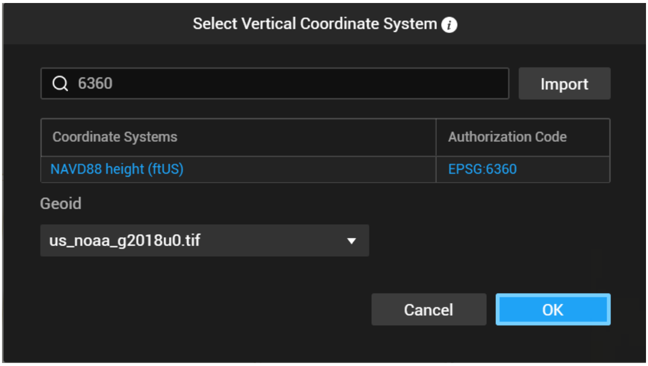
2. **Searching:** From the drop-down menus of Horizontal Settings and Vertical Datum Settings, select "Horizontal Coordinate System Database" and "Vertical Coordinate System Database". Enter the coordinate system name or authorization code, select the corresponding search result, then click "OK". The WGS 84 is the most commonly used UTM projected coordinate

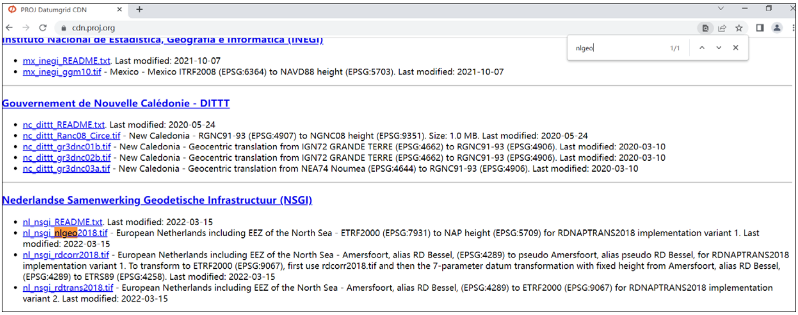
system in the world, DJI Terra will automatically calculate the UTM zone number where the current data is located. Users can check whether the zone number is correct according to the following formula: (longitude)/6+31 and then round the result. For example: if the longitude of data is 116.3241, based on the formula (116/6+31=50.38375), the WGS84 UTM zone number is 50N. If users need to use other projected coordinate systems, log in to https://epsg.io/ to query the EPSG zone number according to the country and region or the latitude and longitude coordinates, and then search for it and apply in DJI Terra.

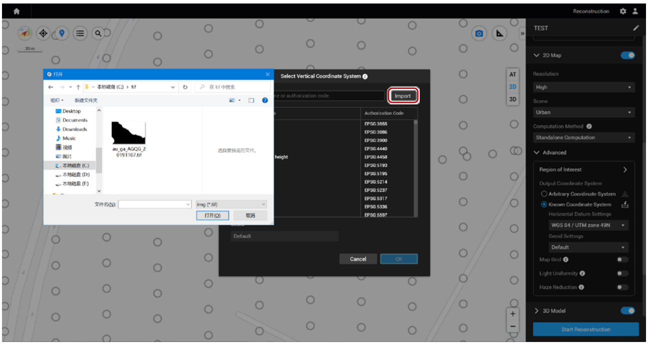


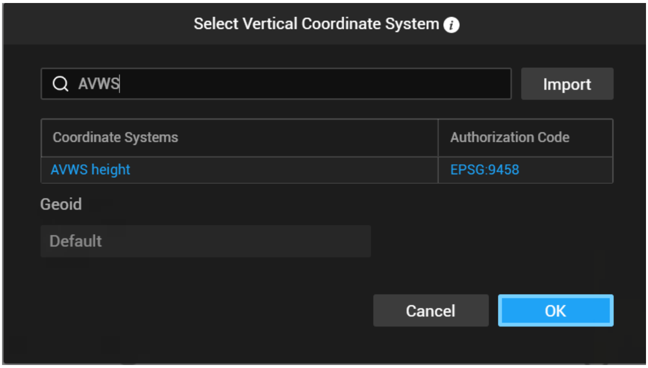


If the selected vertical coordinate system requires importing a corresponding geoid file, you can search and download the required file on the website https://cdn.proj.org/. Import the downloaded file to DJI Terra and then start the reconstruction.




PROJ Datumgrid CDN
cdn.proj.org
nlgeo
1/1
Instituto Nacional de Estadística, Geografía e Informática (INEGI)
mx_inegi_README.txt. Last modified: 2021-10-07
mx_inegi_ggm10.tif - Mexico - Mexico ITRF2008 (EPSG:6364) to NAVD88 height (EPSG:5703). Last modified: 2021-10-07
Gouvernement de Nouvelle Calédonie - DITTT
nc_dittt_README.txt. Last modified: 2020-05-24
nc_dittt_Ranc08_Circe.tif - New Caledonia - RGNC91-93 (EPSG:4907) to NGNC08 height (EPSG:9351). Size: 1.0 MB. Last modified: 2020-05-24
nc_dittt_gr3dnc01b.tif - New Caledonia - Geocentric translation from IGN72 GRANDE TERRE (EPSG:4662) to RGNC91-93 (EPSG:4906). Last modified: 2020-03-10
nc_dittt_gr3dnc02b.tif - New Caledonia - Geocentric translation from IGN72 GRANDE TERRE (EPSG:4662) to RGNC91-93 (EPSG:4906). Last modified: 2020-03-10
nc_dittt_gr3dnc03a.tif - New Caledonia - Geocentric translation from NEA74 Noumea (EPSG:4644) to RGNC91-93 (EPSG:4906). Last modified: 2020-03-10
Nederlandse Samenwerking Geodetische Infrastructuur (NSGI)
nl_nsgi_README.txt. Last modified: 2022-03-15
nl_nsgi_nlgeo2018.tif - European Netherlands including EEZ of the North Sea - ETRF2000 (EPSG:7931) to NAP height (EPSG:5709) for RDNAPTRANS2018 implementation variant 1. Last modified: 2022-03-15
nl_nsgi_rdcorr2018.tif - European Netherlands including EEZ of the North Sea - Amersfoort, alias RD Bessel, (EPSG:4289) to pseudo Amersfoort, alias pseudo RD Bessel, for RDNAPTRANS2018 implementation variant 1. To transform to ETRF2000 (EPSG:9067), first use rdcorr2018.tif and then the 7-parameter datum transformation with fixed height from Amersfoort, alias RD Bessel, (EPSG:4289) to ETRS89 (EPSG:4258). Last modified: 2022-03-15
nl_nsgi_rdtrans2018.tif - European Netherlands including EEZ of the North Sea - Amersfoort, alias RD Bessel, (EPSG:4289) to ETRF2000 (EPSG:9067) for RDNAPTRANS2018 implementation variant 2. Last modified: 2022-03-15


Select Vertical Coordinate System
Import
Authorization Code
Default
Cancel
OK
TEST
2D Map
Resolution
High
Scene
Urban
Computation Method
Standalone Computation
Advanced
Region of Interest
Output Coordinate System
Arbitrary Coordinate System
Known Coordinate System
Horizontal Datum Settings
WGS 84 / UTM zone 49N
Geoid Settings
Default
Map Grid
Light Uniformity
Haze Reduction
3D Model
Start Reconstruction


Select Vertical Coordinate System
AVWS
Import
Coordinate Systems
Authorization Code
AVWS height
EPSG:9458
Geoid
Default
Cancel
OK

Output Coordinate System - Arbitrary Coordinate System - Seven-Parameter Transformation

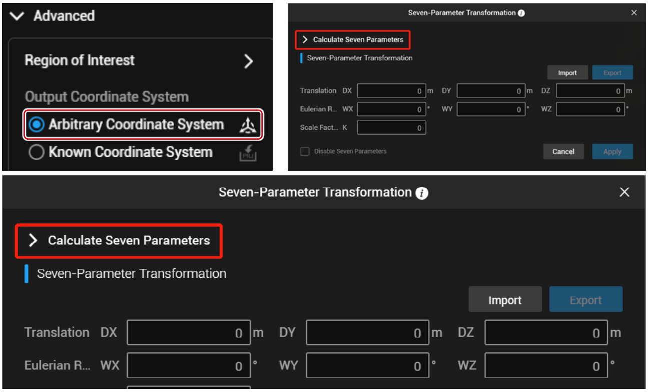
Seven parameters enable the conversion between any two coordinate systems. When a survey needs to produce output based on a local coordinate system, seven-parameter transformation would normally be used to convert geodetic coordinate systems such as WGS 84 or CGCS 2000 to a local coordinate system. In the 2D map and 3D model functions on DJI Terra, you may select "Seven-Parameter Transformation" or "Calculate Seven Parameters" under "Arbitrary Coordinate System" to generate output based on a local coordinate system. The steps are as follows:

1. Create a data file according to the data import format required by seven-parameter transformation (as shown below). DJI Terra supports the import of data in TXT or CSV format. The data information and format requirements are as follows:
   Coordinate name, latitude (B, degree format), longitude (L, degree format), altitude (H), east (x), north (y), and height (z)

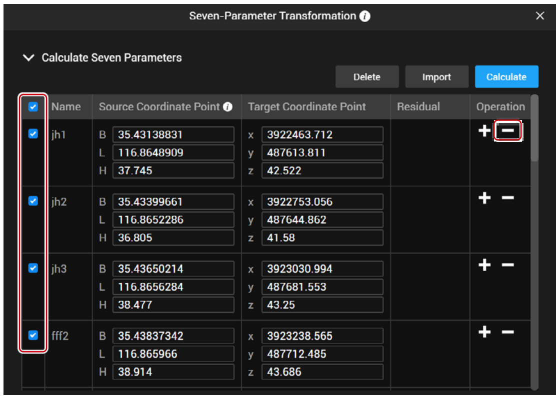
⚠ Data items in a TXT file shall be separated by commas (,) and tabs. Please ensure at least 3 sets of coordinates are used in seven-parameter calculation.

Name	Latitude	Longitude	Altitude	X	Y	H
1	35.43139	116.8649	37.745	487613.8	3922464	42.522
2	35.434	116.8652	36.805	487644.9	3922753	41.58
3	35.4365	116.8656	38.477	487681.6	3923031	43.25
4	35.43837	116.866	38.914	487712.5	3923239	43.686
5	35.42956	116.8679	40.322	487882.5	3922260	45.086
6	35.42993	116.8718	40.726	488241.6	3922301	45.472

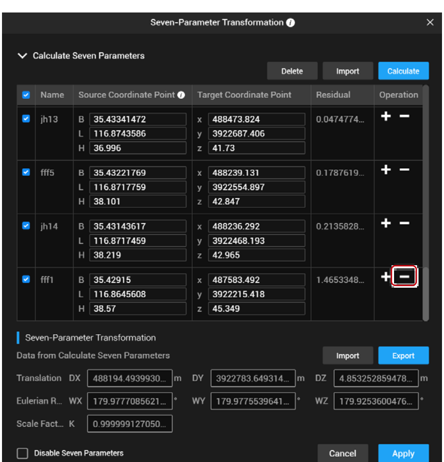
2. In "2D Map"/"3D Model", click "Advanced Settings", select "Arbitrary Coordinate System", and click "Seven-Parameter Transformation Settings". In the "Seven-Parameter Transformation" pop-up window, click ">Calculate Seven Parameters" to expand the menu, click "Import", then select the prepared data in Step 1 to import it.

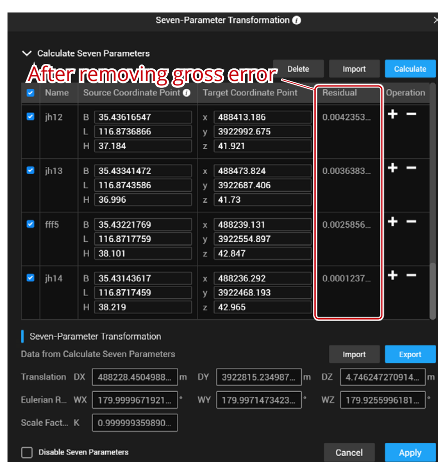


3. After importing the data, check whether B/L/H and x/y/z correspond correctly to the order of “Latitude/Longitude/Height” and “East/North/Height”. Note that the x/east coordinate is usually 6 or 8-digit, while the y/north coordinate is normally 7-digit. Headings or other irrelevant information can also be removed using “-” in the “Operation” menu.



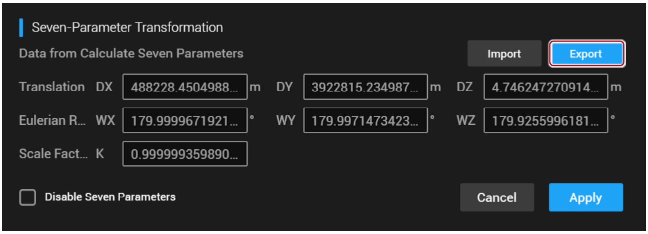
4. After clicking “Calculate”, you will see the results of the seven-parameter calculation and its residual. Preferably, the residual should be smaller than 0.5 of the expected output accuracy (if the expected accuracy is 5 cm, the recommended residual should be smaller than 0.025 m), so that the transformation result is more accurate. If the residual is too large, you may use “-” to remove the gross error, then click “Calculate” again. After ensuring the residual meets the requirement, click “Apply” to complete the calculation and apply the seven parameters.





5. If you will be processing data in the same area in the future, you may click “Export” directly to save the seven parameters in the JSON format. On your next processing, you can then import and reapply the file directly without having to calculate again.

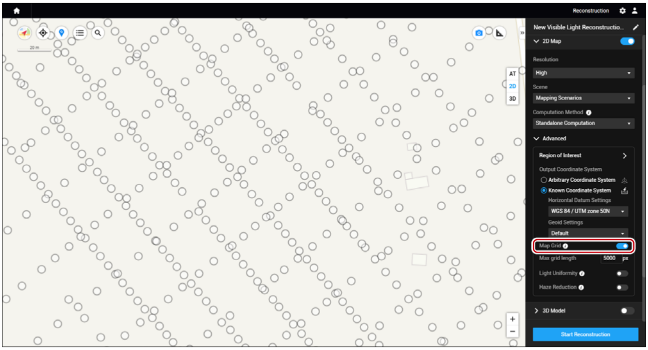
⚠ Similar to the GCPs, coordinates used for seven-parameter calculation should be distributed evenly around the measured area and do not necessarily have to be in the area. However, they must not be concentrated in a small zone within the measured area, otherwise the seven parameters would still result in significant offset when far from the computed area despite having produced a high residual.



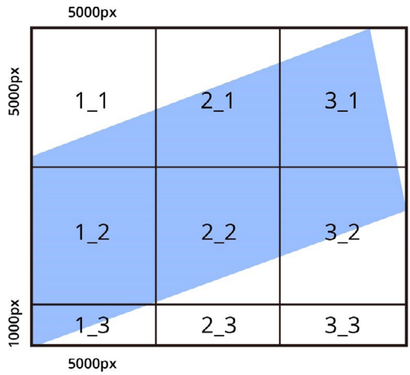
Map Grid

When the data of a raw image is too large, the DOM/DSM TIF image generated may be too big or too slow to load when being imported into third-party software. In these situations, we recommend using the Map Grid function where you can divide a large TIF file into several smaller ones.

1. Enable the “Map Grid” button, set the maximum grid length in pixel.



2. The software will split the DOM/DSM output into blocks as shown below (using 5,000 pixel as an example).

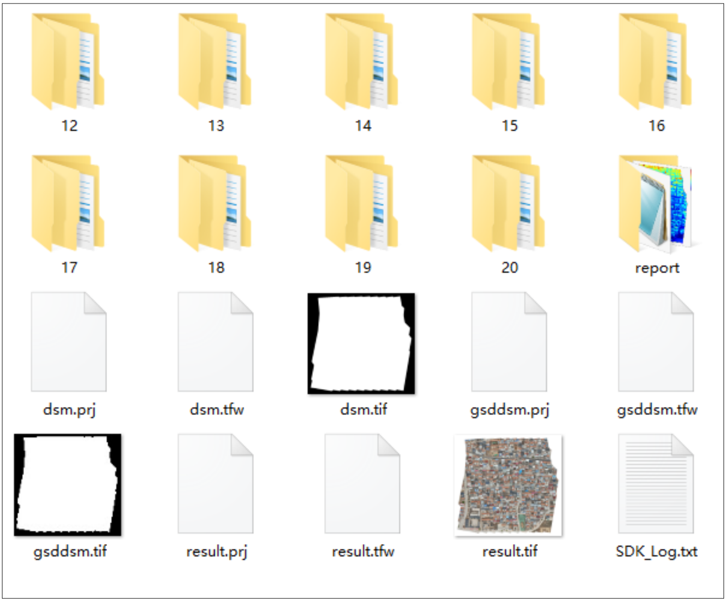


- Map grid output will not replace the original DOM or DSM image. Both files will co-exist.
- The resulting files will be saved in the output folder of the corresponding mission: 1) Mission name\map\dsm_tiles; 2) Mission name\map\result_tiles.
- The minimum output grid length is 1,000 pixel.
- Output files bigger than 4GB will contain BigTIFF parameters, while those smaller than 4GB will not (certain third-party software does not support BigTIFF images, in which case the grid length should be reduced).

After setting the relevant parameters, click “Start Reconstruction” to begin 2D reconstruction.

2D Map File Format and Storage Path

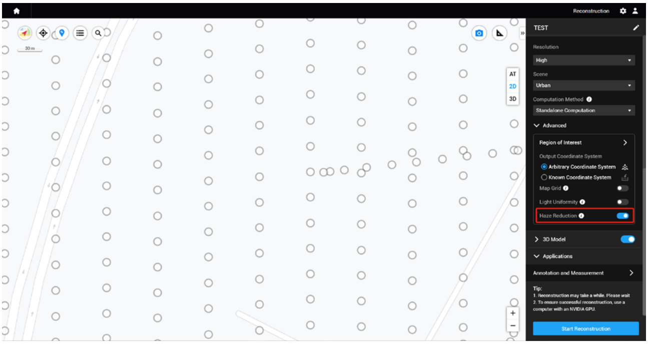
2D map files are saved to this path by default. You can change the cache directory in Settings.
C:\Users\< Computer user name >\Documents\DJI\DJI Terra\<DJI account name >\< Mission name >\map\
You can also press the shortcut keys “Ctrl+Alt+F” on the reconstruction page to open the folder of the current mission. An output file contains the following key information:
result.tif: Digital Orthophoto Map (DOM), which is the main output of 2D reconstruction.
dsm.tif: Digital Surface Model (DSM), which is a geoid file for the mission area with each pixel containing its latitude, longitude, and altitude.
gsddsm.tif: a DSM with a 5 MP resolution after downsampling, which can be imported for use during terrain following with Matrice 300 or Phantom 4 RTK.
Digital folder (such as 12-21): map tile data, used for displaying 2D models in DJI Terra and that adopts the same tile classification as Google. Map tiles are standard. If they need to be used on a third-party platform, they can be called based on the tile calling convention.
“result_tiles” folder: the folder in which map grid split results of orthophotos are saved.
“dsm_tiles” folder: the folder in which map grid split results of geoid files are saved.

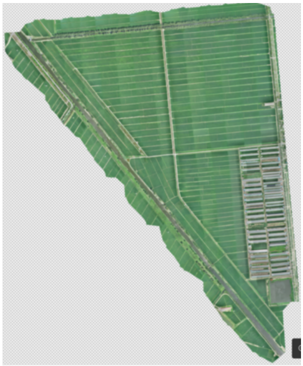


There will also be a ".temp" folder in the output folder. It is larger in size and stores intermediate files from model reconstruction. These files be required if you wish to perform additional actions such as creating a new file format or modifying a coordinate system during or after a reconstruction. If no other actions are necessary after reconstruction, you may delete the intermediate files manually to free up storage space.

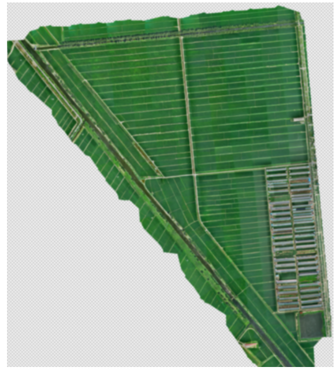
Haze Reduction

For hazy scenes, a "misty" effect may occur on orthophotos. In such circumstances, you may enable the "Haze Reduction" feature to optimize the issue.





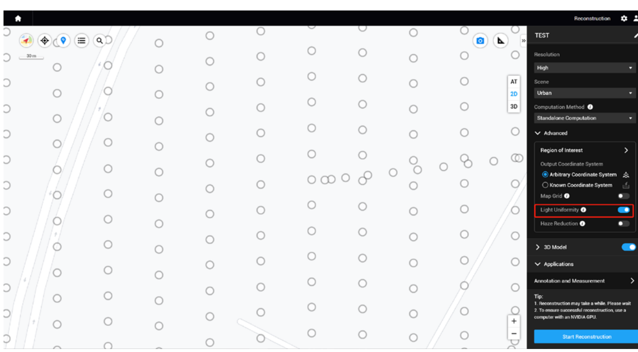
Before enabling “Haze Reduction”

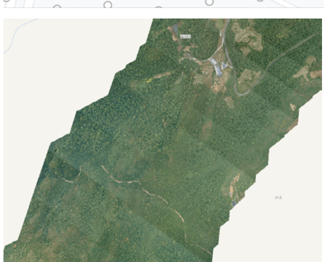


After enabling “Haze Reduction”

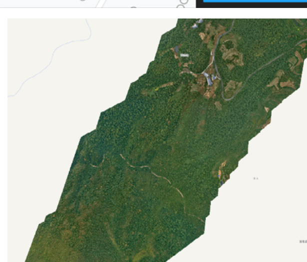
Light Uniformity

In strong lighting environment, a mirror-like reflection effect will be produced due to glossy surfaces of land or crop canopy, leading to light on one side and shade on the other, and reconstruction output will have stripes with gradients. When this happens, enabling the “Light Uniformity” feature will even out the overall light and color of the image.





Before enabling “Light Uniformity”



After enabling “Light Uniformity”

Quality Report for 2D Reconstruction

After the model is reconstructed, click "Quality Report" to view its overall condition. You can check the output's resolution, covered area, reconstruction time, and other details in the report. Note that the entire 2D reconstruction duration should be the total time taken for these four steps: aerotriangulation; image distortion correction and color correction; densification; and TDOM generation.

Image Information Overview

Item	Value
Number of Images	930
Image with Camera POS	930
Calibrated Image	930
Constrain with Image POS Data	Yes
Georeferencing RMSE	0.021 m
Connected Components	1
Max Components Images	930
Aerotriangulation Time	7.205min

Map Information Overview

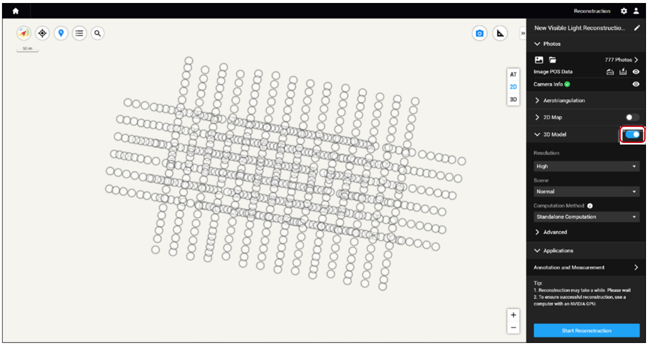
Item	Value
TDOM GSD	0.059 m
Covered Area	0.228853 km^2
Average Flight Altitude	202.817 m

Performance Overview

Stage	Time
Image Distortion Correction and Color Correction	1.985min
Densification	8.333min
TDOM Generation	26.793min

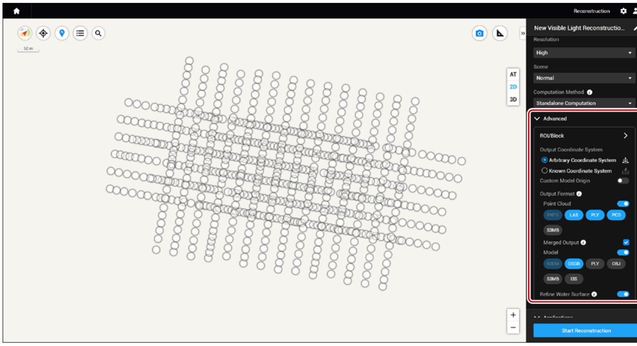
3D Reconstruction

Enable the “3D Reconstruction” button and set the relevant parameters.



1. **Setting Reconstruction Resolution**
   “High” means the original resolution, “Medium” means 1/2 of the original resolution (i.e. the image length and width are 1/2 of the original), and “Low” means 1/4 of the original resolution (i.e. the image length and width are 1/4 of the original). For example: if the resolution of the original shots is 6000×6000, that would be the high resolution; the medium resolution would be 3000×3000 and the low resolution 1500×1500.
2. **Selecting Appropriate Mapping Scene**
   Normal: Applicable to most scenarios, including oblique photography and orthophotography.
   Circle: Applicable to circling scenarios and especially for reconstructions of small and vertical objects, such as base stations, towers, and wind-driven generators.
   Power Lines: Applicable to scenarios where power lines are to be captured with visible light and their point clouds will be reconstructed. Note that for power line scenes, the software will only generate point clouds and not 3D models. Power line scenarios are only supported by the Electricity and Cluster versions.
3. **Selecting Computation Method**
   When using the Cluster version, you may choose cluster computation for the reconstruction, which will greatly increase processing efficiency and volume. For the relevant settings for cluster reconstruction, please refer to the “Cluster Reconstruction” chapter. If the computer only has permission for standalone computation, no such options will be available.

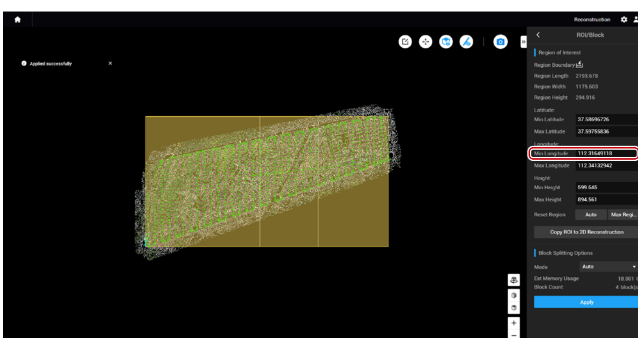
4. Advanced Settings



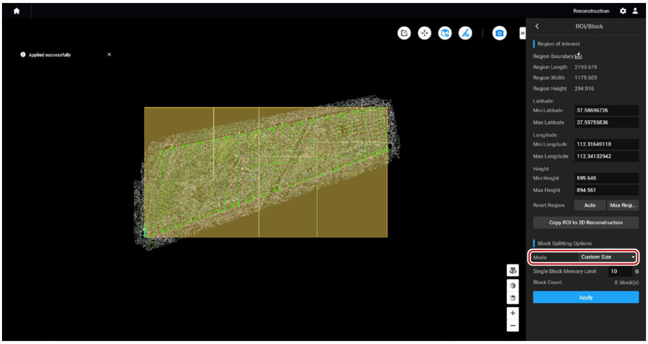
ROI/Block Splitting

For details on ROI settings, please refer to the “2D Reconstruction - Region of Interest” chapter. To ensure efficiency, the software will set the maximum block size based on the computer’s RAM. However, certain scenes (such as for importing third-party model editing software) require the block size to be sufficiently small, in which case a custom block size will have to be set. DJI Terra provides the following block splitting methods:

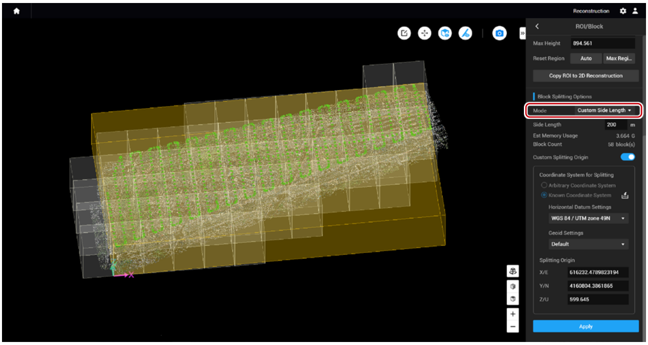
1. **Auto:** maximizes the blocks automatically based on the device’s current available RAM.



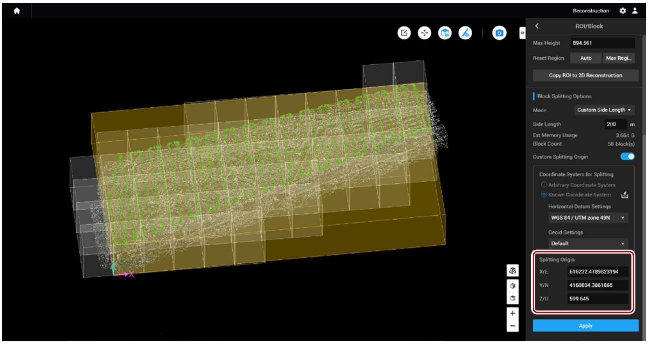
2. **Custom RAM:** You input the maximum RAM allocated for processing a single block, and the software splits the blocks according to the input RAM value.



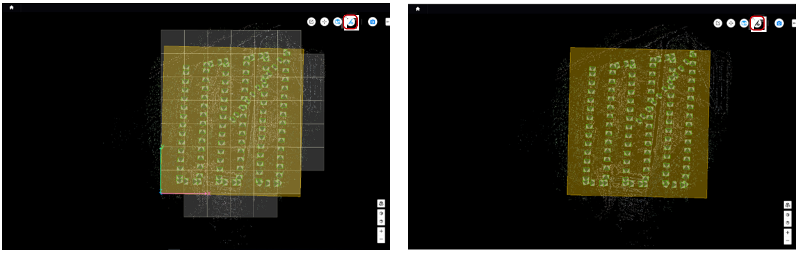
3. **Custom Side Length:** The software divides the blocks based on the side length input by you, and the software will show the RAM and block count required for the block splitting within the current distance.



4. **Custom Splitting Origin:** This enables you to define a custom coordinate system and coordinate values for the splitting origin. To update a model, you can set a common splitting origin and replace the corresponding blocks. This function must be used together with "Custom Model Origin" to achieve a satisfactory model update.



5. Click "**Display blocks**" to enable/disable the block splitting effects.

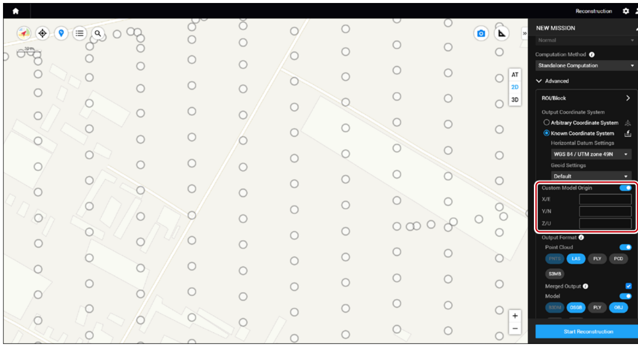


⚠ The smaller the blocks, the slower the reconstruction. Use this feature after performing Aerotriangulation.

Output Coordinate System

Please refer to the "2D Reconstruction - Output Coordinate System" chapter.

Custom Model Origin



Take the OSGB format for example, in order to minimize its size, each OSGB file contains coordinates that are relative to the model origin. When multiple missions need to be displayed on a model display platform, the model origins of the missions can be set as the same coordinates. When a model needs to be partially updated, you can set the new origin as the old origin and apply the same splitting origin. This way the blocks to be updated can be copied and replaced directly.

The model's origin coordinate system must be the same as its output coordinate system. After completing the settings, begin the reconstruction. The model origins of output in OSGB, OBJ and PLY format will be set as the coordinates of the input point, and the origin's location will be written into the "metadata.xml" file:


```
<?xml version="1.0" encoding="utf-8"?>
<ModelMetadata version="1">
    <!--Spatial Reference System-->
    <SRS>EPSG:32649</SRS>
    <!--Origin in Spatial Reference System-->
    <SRSOrigin>211257.696628167,2524955.9437090615,198.29999999883267</SRSOrigin>
    <Texture>
        <ColorSource>Visible</ColorSource>
    </Texture>
</ModelMetadata>
```


Output Format

DJI Terra's 3D output contains the following formats:

Point Cloud

1. PNTS: Default format for display in DJI Terra (LOD point cloud format, suitable for display in Cesium)
2. LAS: ASPRS LASer, 3D cloud point format, V1.2
3. S3MB: SuperMap LOD point cloud format
4. PLY: Non-LOD point cloud format
5. PCD: Non-LOD point cloud format

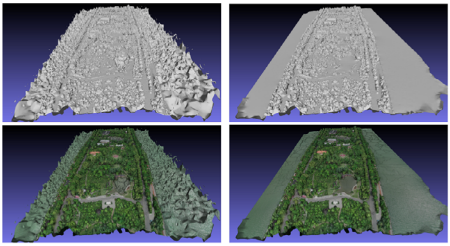
Merged Output: If the selected point cloud format is LAS, PLY or PCD, you can enable the "Merged Output" feature to merge the point cloud output into a single file.

Model

1. B3DM: Default format for display in DJI Terra (LOD model format, suitable for display in Cesium)
2. OSGB: LOD model format
3. PLY: Non-LOD model format
4. OBJ: Non-LOD model format
5. S3MB: SuperMap LOD model format
6. I3S: LOD model format

LOD (Level of Detail) applies to models with multiple layers of detail. It involves saving a model in pyramid form and as multiple small tiles. Usually, it is faster to browse a model in LOD form.

Refine Water Surface: This feature automatically identifies any body of water within the measured area and flattens the model to create an even water surface.



Before enabling "Refine Water Surface"   After enabling "Refine Water Surface"

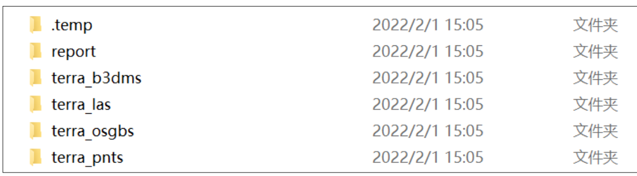
After setting the relevant parameters, click "Start Reconstruction" to start 3D reconstruction.

3D Reconstruction File Format and Storage Path

3D reconstruction resulting files are saved to this path by default. You can change the cache directory in settings, and can also press the shortcut keys “Ctrl+Alt+F” on the reconstruction page to open the folder of the current mission.

C:\Users\< Computer user name >\Documents\DJI\DJI Terra\< DJI account name >\< Mission name >\models\pc\0

Once a format is selected, the folder storing outputs in that format will usually be named as “terra_XXX” (XXX being the model format). For example, a folder named “terra_osgbs” would store 3D models in the OSGB format.



There will also be a “.temp” folder in the output folder. It is larger in size and stores intermediate files from model reconstruction. These files be required if you wish to perform additional actions such as creating a new file format or modifying a coordinate system during or after a reconstruction. If no other actions are necessary after reconstruction, you may delete the intermediate files manually to free up storage space. This will not affect the output.

- If 2D and 3D reconstruction are required at the same time, you may enable both the “2D Reconstruction” and “3D Reconstruction” buttons, and the software will perform 2D reconstruction first before 3D reconstruction.
- The ROI, coordinate systems and other parameters for 2D and 3D reconstruction can be set separately.

Quality Report for 3D Recontruction

After the model is reconstructed, click "Quality Report" to view its overall condition. You can check the various parameter settings for the model reconstruction in the report. Note that 3D reconstruction includes two steps: aerotriangulation and MVS. Therefore, the 3D reconstruction time should be the total time spent for aerotriangulation and MVS.

Image Information Overview

Item	Value
Number of Images	930
Image with Camera POS	930
Calibrated Image	930
Constrain with Image POS Data	Yes
Georeferencing RMSE	0.021 m
Connected Components	1
Max Components Images	930
Aerotriangulation Time	7.205min

DJI Terra Quality Report for 3D Reconstruction

Parameters

Parameters	Value
Mapping Scene	Normal
Resolution	High
Cluster Computation	No
Refine Water Surface	No

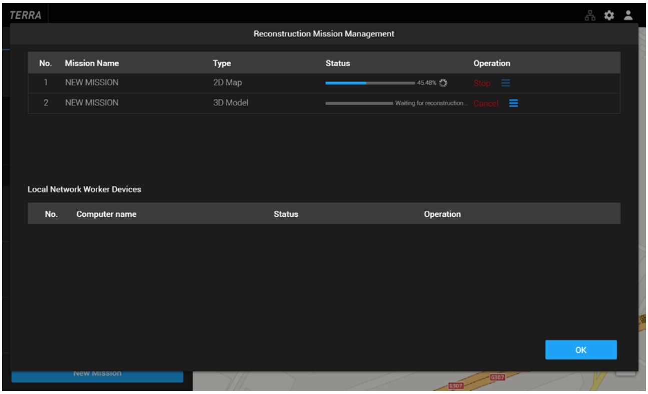
Performance Overview

Item	Value
MVS Divide Mode	Auto
MVS Block Count	8
MVS Time	4h 9.214min

Output

Output List
B3DM File
PNTS File
OSGB File
LAS File

Reconstruction Mission Management



1. After starting a reconstruction mission, you can click [icon] on the home page to enter the reconstruction mission management page.
2. Select standalone computation, and the reconstruction mission queue will appear at the top of the page, where you can check each mission's name, reconstruction type, and progress status. You can pause or cancel a mission on the action bar. Click [icon] and drag to sort the missions.
3. Select cluster computation, and a local network worker device list will appear at the bottom of the page. It is similar to the cluster reconstruction device list displayed on the cluster reconstruction settings page. If a worker device status error happens, click the "Release" button on the action bar to release the worker device. A released worker device will no longer participate in the current reconstruction.

For other frequently asked questions on reconstruction, please refer to the cluster reconstruction section in "DJI Terra FAQ". on our official website.

FAQ

For frequently asked questions on reconstruction, please refer to "DJI Terra FAQ" on our official website.

Cluster Reconstruction

Function Overview

Cluster reconstruction means the processing of a mission using multiple computers at the same time. It is able to handle larger missions with efficiency that is several times higher than normal reconstruction. The basic process flow for cluster reconstruction is as follows: Open the cluster computation engine on the worker device -> set up cluster control management on the control device, and select the devices to participate in the computation -> select "Cluster Reconstruction" for the computation method during reconstruction -> start the mission as a normal 2D/3D reconstruction.

For how to perform cluster reconstruction, you may refer to the tutorial video "DJI Terra - Using the Cluster Version". Note that the tutorial was produced based DJI Terra v3.1 and the UI may differ from that of the v3.6 version.

Preparation before performing cluster reconstruction

1. Server room configurations
2. Equipment configurations
3. Equipment parameter configurations

Reference: "Preparation Before Using DJI Terra".

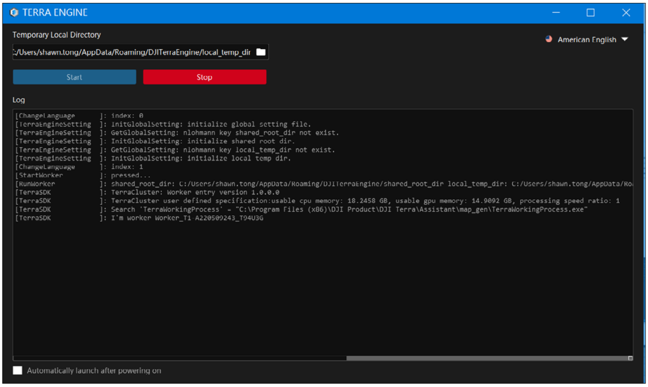
The Cluster version involves the concepts of "control device" and "worker device".

Control device: It runs the desktop client for DJI Terra Cluster, and supports functions such as setting cluster reconstruction parameters, selecting worker devices, and viewing mission statuses. As the scheduling platform for an entire reconstruction mission, reconstruction missions are managed on the control device. The license for the Cluster version is bound to the control device. Worker devices can be changed any time as needed, while the aftersales unbinding process would be required to change a control device.

Worker device: Other equipment for which a control device may allocate reconstruction missions after a cluster computation engine has been enabled in a local area network.

Operating a Worker Device

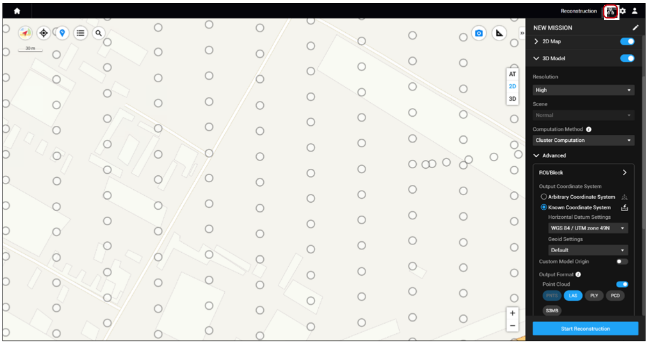
A worker device is a computation engine. Its relevant programs are installed automatically together with the DJI Terra software. You can find the worker device program, "DJI TerraEngine.exe", in the "Cluster" folder under the installation directory or in "Start programs > DJI product", and enable it as shown below.



1. Local temporary directory: For temporary storage during computation by worker devices. Please set the directory in the local directory of the worker devices and ensure there is sufficient disk space. If a worker device is also enabled for the control device, do not place the local temporary directory and the shared directory on the same location to avoid read-write conflict.
2. Enable/Disable: During cluster reconstruction, a worker device must be enabled in order to be found and used by a control device in the same local network.
3. Log: The print window for the worker device log. If no error has been reported on the control device, you may ignore the process log.
4. Language switch: You can switch between different languages with the button at the top right of the page.
5. Automatically launch after powering on: Enabling this will launch this worker device program automatically when the computer starts.
6. One to many: A high-spec computer may be able to support multiple worker devices at the same time, boosting cluster reconstruction efficiency. To perform this, the computer must meet certain graphics card memory and RAM specifications. If the weakest worker device in the cluster has a graphics card memory of 4G while the most powerful worker device has 12G, and the RAM of the most powerful machine is also greater than that of the weakest machine by 3 times, then you may enable 3 worker devices simultaneously on the most powerful machine.

Operating a Control Device

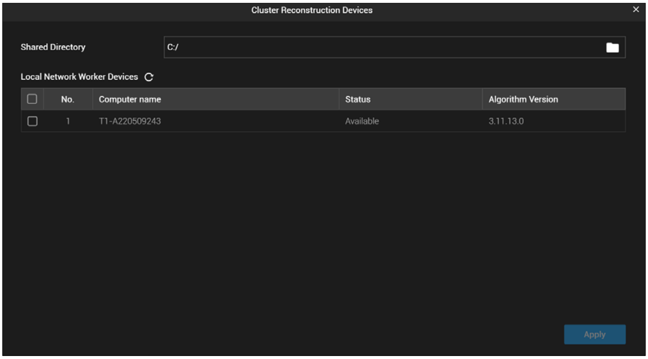
After ensuring the Cluster version license has been exchanged and imported, and that you are logged in offline, click on the top right corner of the DJI Terra home page to enter the cluster reconstruction device list. Note this icon is only visible on devices bound with the Cluster version. It will not show on devices with permission for the standalone version only.



Shared file storage directory and settings: We recommend setting this on a Network Attached Storage (NAS). For how to perform that, please refer to “Preparation Before Using DJI Terra”.

⚠

- The image path and shared file path must be on the same storage device. The shared file storage directory must use the same path as the directory for adding photos during reconstruction. For instance, they must both use network paths or drive letter paths.
- When using a drive letter path for a shared file storage directory, the mapped drive letter on the worker device corresponding to the network’s location must be the same as that on the control device. For instance, if the control device uses the Z drive, then all the worker devices should be mapped as Z drives.



Local Network Worker Device List

After entering the list, the software will automatically search for all enabled worker devices in the current local area network. The list will display the computer names, statuses, and algorithm versions for the found local network worker devices. Click to refresh the worker device search results and statuses. For details on how to enable worker devices, please refer to the later section on operating a worker device.

1. **Computer name:** Displays the computer name for the worker device.
2. **Status:** Displays the current status of the worker device (busy or idle). When idle, the worker device can be selected as a working device. If you encounter any worker device error (e.g. constantly showing busy status while not in use), click on the right of the status to reset the worker device to idle status.
3. **Algorithm version:** Displays the algorithm version number for the worker device. If it is in blue, it means the version number is consistent with the control device; while red indicates they are different. The algorithm version number must be consistent in order for the worker device to be selected as a working device.
4. Check the box before the serial number to select the worker device as a working device. That means the worker device can be used during cluster reconstruction. After completing the setting, click “Apply” to save the settings. The software license for the Cluster version only binds the control device, while worker devices can be changed at any time as needed. Licensed quantity refers to the number of worker devices that can be selected simultaneously for the same control device. For instance, if you have purchased DJI Terra Cluster that supports 3 worker devices, then you can only select up to 3 devices to participate in the reconstruction even if it can detect 10 worker devices.

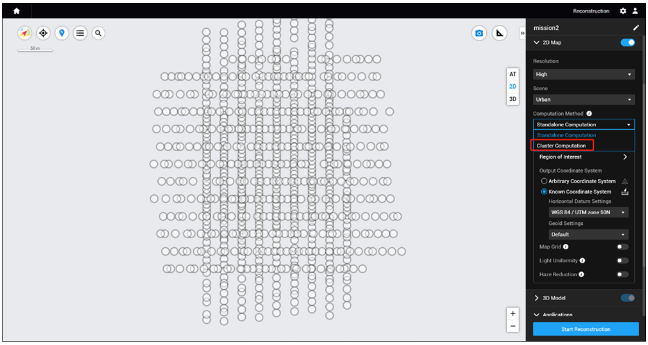
Cluster Reconstruction Process

1. Open “DJITerraEngine.exe” on the worker device, set the local storage directory, enable the cluster computation engine, ensure each worker device can communicate with the control device and access the shared storage directory.
2. Open the cluster management page on the control device, set the shared storage directory, and select the worker devices to participate in the computation.
3. Start reconstruction as per the process of a 2D/3D reconstruction mission, and select “Cluster computation” for the computation method.

You can set whether to use cluster computation for aerotriangulation, 2D reconstruction, and 3D reconstruction respectively.

---

4. Check mission progress and worker device status in reconstruction mission management.
5. If the connection with the shared file storage directory is maintained after completing cluster reconstruction, you can view the reconstruction results in DJI Terra and the output files in the corresponding folders.



2D Multispectral Reconstruction

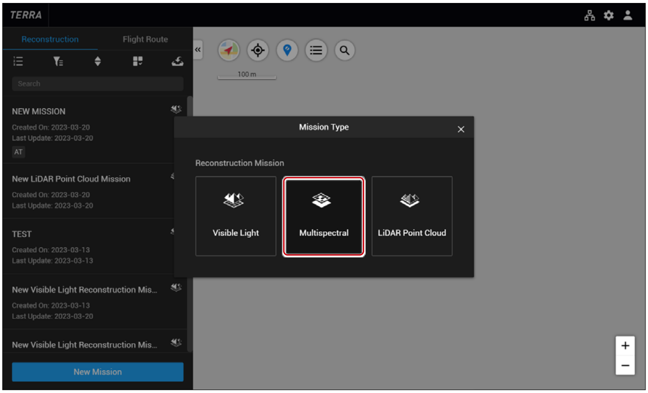
Function Overview

2D Multispectral Reconstruction only supports 2D multispectral map reconstruction using photos captured by a P4 Multispectral. Besides generating DOM and DSM for 2D reconstruction, it can also output vegetation indices such as NDVI and NDRE, as well as composite images for each multispectral band. To output relevant results based on the unit of reflectivity, you can also modify the multispectral data using the "Radiometric Correction" feature.
The basic process of multispectral reconstruction is: Import data -> Radiometric correction (optional) -> Aerotriangulation -> 2D multispectral reconstruction

Importing Data

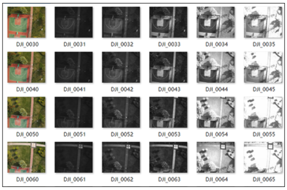
Create Reconstruction Mission

Open and log into DJI Terra, click "New Mission" on the bottom left corner and select "Multispectral" as the mission type.



Add Photos

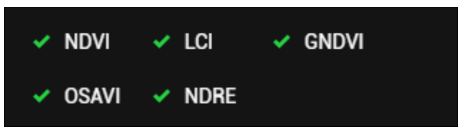
You may add image files or folders. The images imported must contain visible light photos in the JPG format and multispectral single-band photos in the TIF format. Every 6 photos shall form a group, with the last digit of 0-6 corresponding to visible light, red, green, blue, red edge, near infrared respectively. Therefore, the number of photos imported must be a multiple of 6; otherwise, please check if any data is lost or missing. Multispectral reconstruction relies on visible light photos to perform aerotriangulation and then corrects the other multispectral photos based on the overall offset of the camera's structure using the aerotriangulation results. Therefore, the images imported must contain visible light photos. If they are non-visible light photos such as real-time NDVI images, the reconstruction will fail.



Reconstruction successful with visible light photos

Reconstruction fails due to real-time NDVI images

After data is imported, the vegetation index output feature will check the image data. If all appear in green, it means the imported multispectral data works properly and the vegetation indices can be output successfully. If an item is red, it means the data for some bands is missing and you need to check and re-import the data.



Radiometric Correction (Optional)

Most of the settings for multispectral reconstruction are similar to visible light reconstruction. Generally, you may set the relevant parameters based on the 2D reconstruction process. The biggest difference with 2D multispectral reconstruction is the addition of the "Radiometric Correction" module in 2D Map > Advanced Settings. Note that this module is optional. If you need to output single-band maps with reflectivity as the results or conduct index research other than on vegetation indices output by DJI Terra, you may use "Radiometric Correction" first to generate more accurate multispectral output.

Radiometric correction reduces the impact of factors such as weather and time, helping to output more reliable index values for the reconstruction mission. After performing radiometric correction on the multispectral photos, you may reconstruct them into 2D multispectral maps with reflectivity as the output results. Click the "Radiometric Correction" button in "Advanced Settings" to enter the radiometric correction page and perform the relevant steps. After completing radiometric correction, return to the reconstruction page to start the mission. The final reconstruction result will incorporate the effect of the radiometric correction.

Before performing radiometric correction, you need to shoot several calibration board photos with known reflectivity using a DJI Phantom 4 Multispectral. For how to conduct field operations, please refer to the article "Handy Tips for Using DJI Phantom 4 Multispectral".

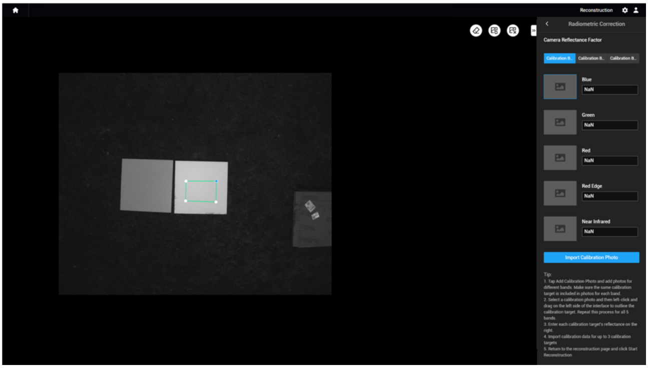
Importing Calibration Board Data

For radiometric correction, import at least one set of calibration board photos for different bands. You may import up to 3 sets of photos, namely Calibration Board 1, 2, and 3 respectively.

1. Select the corresponding calibration board group: Calibration Board 1, 2 or 3.
2. Click “Import Calibration Photo” and select photos for the blue, green, red, red edge, and near-infrared bands with calibration boards, and import them.
3. Click a photo for a certain band, and it will appear in the area on the left.
4. Click or to replace or delete the current photo.
5. Input the corresponding reflectivity index in the text box for each band.

Marking Calibration Board Zones

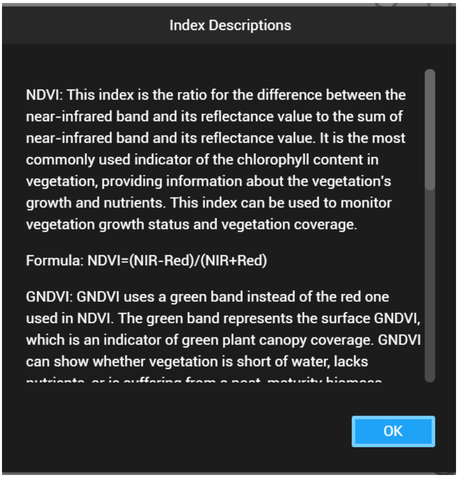
1. Left-click your mouse on the photo on the left to manually add points to mark the boundaries of the area where the calibration board is located.
2. Drag the boundary points to adjust their locations.
3. Click to remove all boundary points from the current photo.
4. Mark the calibration board boundaries of the photos for all bands.
5. The boundaries of a calibration board zone will be automatically applied to the next group of calibration board photos; if this results in any deviation, drag the boundary points to adjust accordingly.



Output Indices

DJI Terra supports the output of five vegetation indices: NDVI, GNDVI, NDRE, LCI, and OSAVI. Each requires image data for a different band. The software will display the indices that can be calculated based on the bands covered by the photos imported by you. If any band is missing, a reminder will appear below the output index. After completing reconstruction, you may click the corresponding index button on the map to view the map reconstruction result for that index.

If a band is missing in any one group of imported photos, the photos for that band will be incomplete. You can view their details in the photo list.



2D Multispectral Map File Format and Storage Path

The reconstruction results for 2D multispectral maps contain grid data in the GeoTIFF format, which can be used by third-party software compatible with the GeoTIFF format. The reconstruction results will include multispectral maps corresponding to each index, narrowband maps for each band, and RGB 2D orthomaps. These files are saved to the following paths. You can change the cache directory in settings, and can also press the shortcut keys “Ctrl+Alt+F” on the reconstruction page to open the folder of the current mission.

The default storage path for multispectral index maps:
C:\Users\< Computer user name >\Documents\DJI\DJI Terra\< DJI account name >\< Mission name >\ map\ index_map

The default storage path for narrowband maps for each band and RGB 2D orthomaps:
C:\Users\< Computer user name >\Documents\DJI\DJI Terra\< DJI account name >\< Mission name >\map

Where “result.tif” refers to a RGB 2D orthomap, while “result_XXX.tif” refers to a narrowband map for the band corresponding to “XXX”.

LiDAR Point Cloud Processing

Function Overview

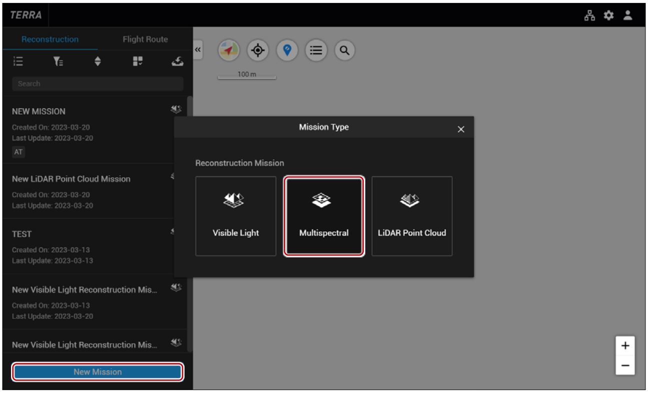
DJI Terra only supports LiDAR processing of data from Zenmuse L1. It can process raw LiDAR files from L1 into 3D point clouds in the LAS format. You may import the generated LAS 3D files into point cloud analyzing software for use in surveys or power industry applications.

The basic workflow for LiDAR data processing is: Import data -> Set relevant parameters -> Start reconstruction

Importing Data

Create Reconstruction Mission

Open and log into DJI Terra, click “New Mission” on the bottom left corner and select “LiDAR Point Cloud” as the mission type.



Adding Data

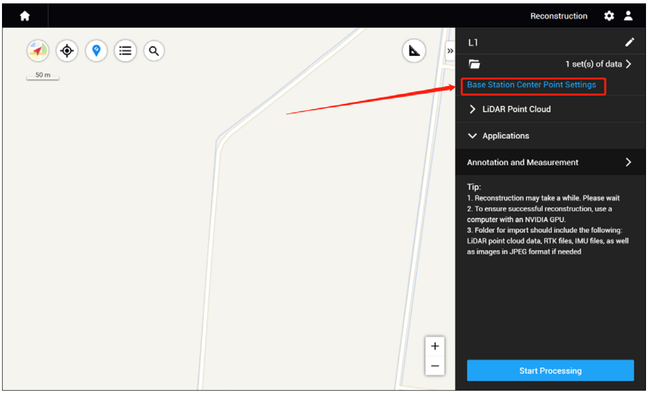
Click 📁 and select a folder named based on data collection time to add and import LiDAR point cloud data. The folder should contain files with the following suffixes: CLC, CLI, CMI, IMU, LDR, RTB, RTK, RTL and RTS. If there are JPG photos, you can generate true-color point clouds; otherwise you will still be able to rereconstruct point clouds. Multiple groups of LiDAR missions may be placed in a big folder, which can be imported when adding data.

If the RTK mode is not used during a flight and you have set up your own D-RTK2 base station or third-party base station, you may copy the D-RTK2 mobile station data (or third-party base station data) for the corresponding time period into the raw data directory, and rename the base station file as: DJI_YYYYMMDDHHMM_XXX.RTB. For more details, please refer to Zenmuse L1 User Manual - Base Station Satellite Data Acquisition.

Base Station Center Point Settings (Optional)

Usage scenario:

1. If the base station is set up at an unknown point, you can obtain the precise coordinates of the base station's central point using third-party software and the static PPP convergence method. Then import the coordinates into DJI Terra to replace the original self-convergent coordinates of the base station.
2. If the base station is set up at a known point and its central point coordinates have not been set during operation, you can define the base station coordinates as known point coordinates before software computation.



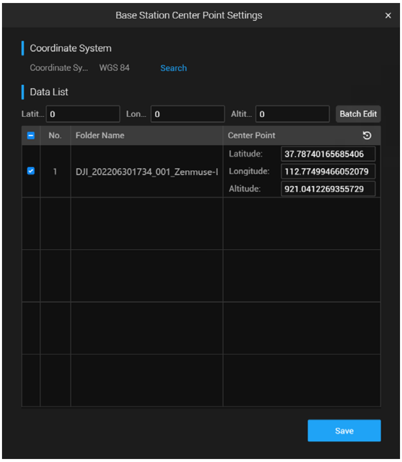
1. After importing the data, click Base Station Center Point Settings.
2. Enter the Base Station Center Point Settings, and click to search for and set the base station's central point coordinate system as the one used when setting up the base station's central point during operation.
3. The data list displays the serial number, folder name, and central point latitude (X), longitude (Y) and altitude (Z).
4. Individual edit: Input data in the fields for central point latitude, longitude, and altitude to modify.

   Note that individual edit:

   a. Supports cut and paste;

   b. Supports the pasting of latitude, longitude, and altitude together, leaving the software to auto-fill the data (separate the values with a space and tab);

   c. Click "Reset" to reset the base station data.
5. Batch edit: Check the box before the serial number and input/paste the data into the fields for latitude (X), longitude (Y), and latitude (Z), then click "Batch Edit".
6. Click "Save" to replace the original base station coordinates.

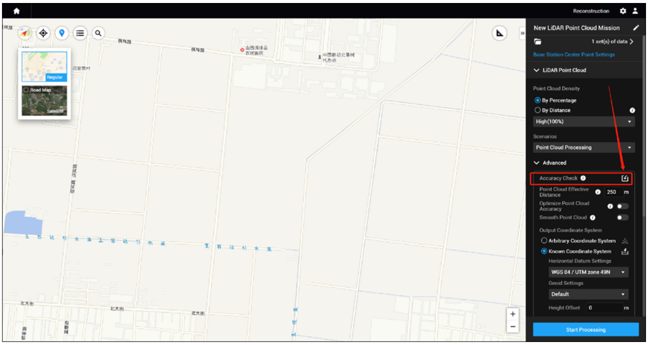


LiDAR Point Cloud Processing Parameter Settings

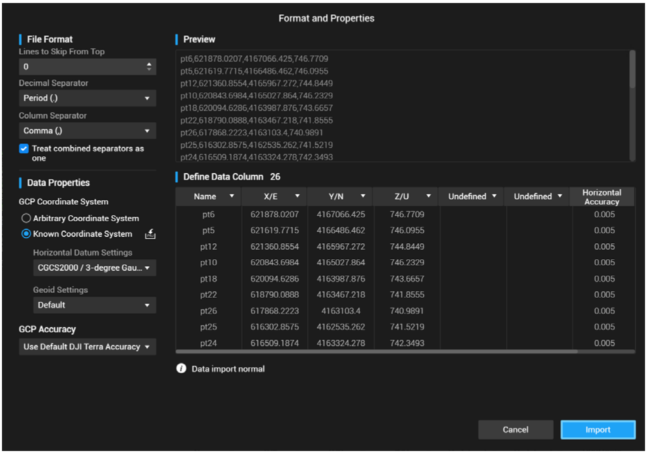
1. **Select point cloud density "By Percentage":** High means the original sampling rate, where 100% of the point clouds are used for processing. This produces the highest quality and is the most time-consuming. Medium point cloud density uses 25% of the point clouds for processing. It creates medium quality and takes a moderate amount of time. Low point cloud density uses 6.25% of the point clouds for processing. This method is the least time-consuming and generates sparse point clouds.
2. **Select point cloud density "By Distance":** You can input any value between 5-50 cm to perform downsampling on the point clouds evenly. The value represents the average point distance. The larger the value, the sparser the point clouds and the faster the processing. Perform operations based on mission's requirements and avoid over-scattering the point clouds.
3. **Select usage scenario:** Point cloud processing can be selected for general scenarios. If color overlap occurs with L1, recalibrate the aircraft to achieve better results. You can select Zenmuse L1 Calibration (after processing is finished, click "Export Calibration File", save the file to the microSD root directory, then insert it into the Zenmuse L1. Once powered on, the aircraft will automatically calibrate using the calibration file, and all computation for subsequent data collection will be based on the calibrated parameters).

Advanced Settings

1. **Accuracy Check:** You can import a checkpoint to check its accuracy. The steps are as follows: Expand "Advanced Settings" and click the "Import" button on the right of "Accuracy Check":



Similar to importing GCPs for aerotriangulation, select the checkpoint file, set the correct coordinate system, adjust the data name, X/E, Y/N, and Z/N, then click "Import".



After data processing is completed, an accuracy report will be generated automatically in the quality report.

2. **Effective Point Cloud Distance:** Sets the effective distance between the point cloud and LiDAR for point cloud processing. If the points captured by the LiDAR exceed the effective distance, the points will be filtered out during processing.

- You can set an effective point cloud distance if you need to reconstruct a nearer target area but will inevitably capture the background in the distance.
- How to set an effective point cloud distance: Estimate the longest linear distance between the LiDAR's location and the target area, and set it as the effective point cloud distance.

3. **Optimize Point Cloud Accuracy:** This feature optimizes point clouds scanned at different times during point cloud processing to improve their overall accuracy. This feature is only available in the Pro and later versions. You are required to purchase and activate its license before use.
4. **Smooth Point Cloud:** This feature smooths and minimizes the noise in point clouds, greatly reducing their density and improving their accuracy. This feature is only available in the Pro and later versions. You are required to purchase and activate its license before use.
5. **Output Coordinate System:** Refer to the section on output coordinate system in Chapter 3 for details. Note that most backend point cloud analyzing software does not support the import of point cloud files with a geographic coordinate system. Therefore, DJI Terra generates its output in the UTM projected coordinate system by default.
6. **Output Format:** 3D point clouds generated by DJI Terra contain the following formats:
   a. PNTS: Default format for display in DJI Terra (LOD point cloud format, suitable for display in Cesium);
   b. LAS: ASPRS LASer, 3D point cloud format, v1.2;
   c. S3MB: SuperMap LOD point cloud format;
   d. PLY: Non-LOD point cloud format;
   e. PCD: Non-LOD point cloud format.
7. **Merged Output:** By selecting LAS, PLY or PCD as the point cloud format, you can enable the "Merged Output" feature, which would merge the point cloud output into a single file.

Start Processing

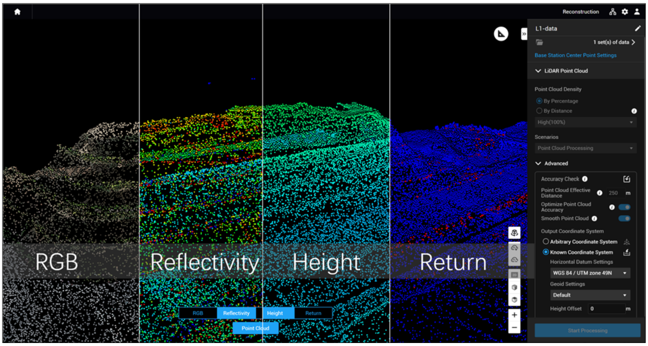
Click "Start Processing" and the progress bar at the bottom will show the processing progress. During processing, you can click "Stop" and the software will save your current progress. If you resume processing after pausing, the software will backtrack a section before the saved progress point and continue the processing.

You can start multiple point cloud processing missions. Before the first started mission is completed, the other missions will be in the queue. Once the previous mission is completed, the next started mission will be processed.

Viewing Output

After completing reconstruction, you can translate, zoom in or out of, or rotate the output, in the same manner as 3D reconstruction models. You can choose to display the output differently at the bottom of the page.

1. RGB: Displays based on true color.
2. Reflectivity: Displays the corresponding color based on the object's reflectivity, in the scale of 0-255. The range of 0-150 corresponds to diffuse objects with a reflectivity of 0-100%, while 151-255 corresponds to fully reflective objects.
3. Height: Displays different colors depending on the cloud point's height.
4. Return: When double return or triple return is selected during data collection, different colors are displayed based on the return information received by the point cloud.



Click "Quality Report" to view and save the report in HTML format. The report contains the relevant information of the raw data, software parameters, output format, and point cloud processing time.

LiDAR Point Cloud File Format and Storage Path

LiDAR point clouds are saved to this path by default. You can change the cache directory in Settings. They can also press the shortcut keys “Ctrl+Alt+F” on the reconstruction page to open the folder of the current mission.

C:\Users\< Computer user name >\Documents\DJI\DJI Terra\< DJI account name >\< Mission name >\< lidars>

In the output folder, the most important files are the 3D point clouds in LAS format and the flight trajectory files in OUT format. The LAS point clouds generated by DJI Terra are standard LiDAR output from aircraft-mounted LiDARs, with a version number of v1.2. Most backend software supports the direct import of such output. LAS point clouds record information such as the 3D point coordinates, RGB colors, reflectivity, time, number of returns, which return the 3D point belongs to, total number of points for each return, and scanning angles.

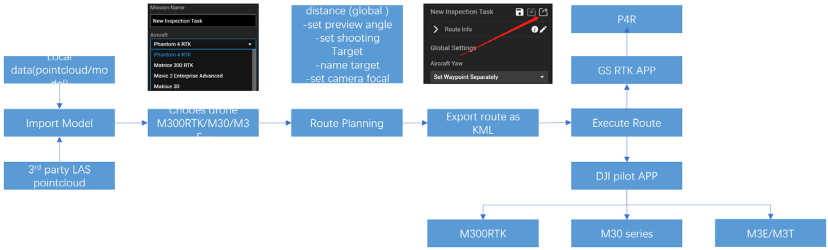
“_sbet.out” indicates a post-processing trajectory file. It records the trajectory information after adjustment calculation. You may import it into third-party software to view the trajectory, or use third-party software to perform a secondary adjustment processing. For details, please refer to “Zenmuse L1 Trajectory File Format Specification” on our the Zenmuse L1 official website.

Detailed Inspection

Function Overview

Designed for inspection of power lines and transmission towers, this feature can be used based on 3D models or point clouds generated by DJI Terra or by importing third-party LAS point clouds. You can select a target to automatically generate waypoints and a flight route, for automatic offline detailed inspection. When planning an inspection route, DJI Terra will display a simulated camera transmission image corresponding to the waypoints, while using the flight route safety check function to create more accurate waypoints and a more efficient and safer route. Generated flight routes can be imported directly into the remote controller to be executed automatically.

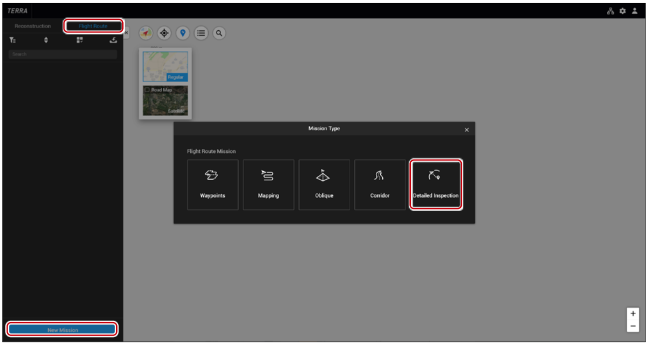
The basic process for Detailed Inspection is as shown below:



Importing Data

New Mission

Open and log into DJI Terra, click "New Mission" at the bottom left corner, then select "Detailed Inspection" as the mission type.

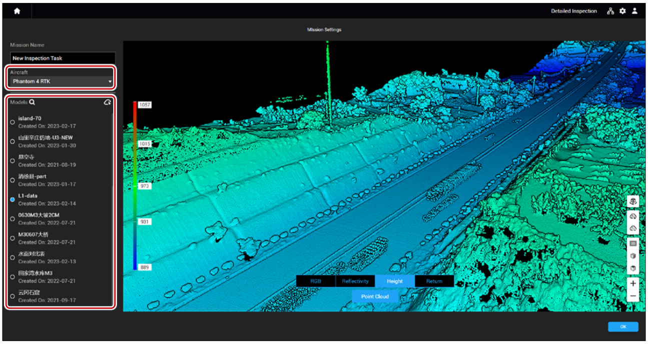


Selecting Aircraft and Adding Data

After creating and naming a detailed inspection mission, select the aircraft for the mission on the left of the interface, click to expand the menu, and select Phantom 4 RTK, Matrice 300 RTK, Mavic 2 Enterprise Advanced, Matrice 30 series, or Mavic 3 Enterprise series. After selecting the aircraft, view the list of models that can be imported on the left of the interface. Select the desired mission, check that it is correct and click "Confirm" on the lower right corner to complete the import.

If there are multiple models, you can click the icon and quickly look up the name of the mission that needs to be imported. To import a third-party LAS point cloud model, click the icon.

⚠ A third-party LAS point cloud model must contain and have the right coordinate system selected, otherwise the import will fail. Point clouds without a coordinate system are not supported.



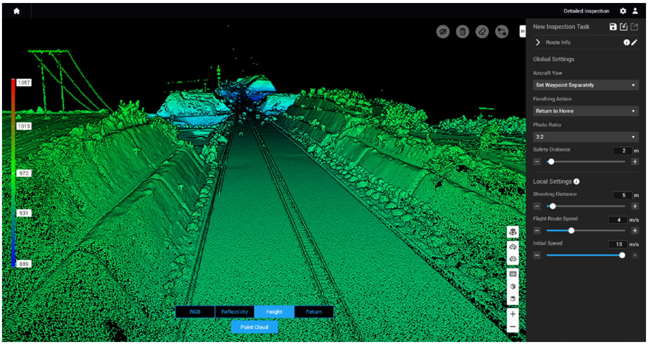
Route Setting and Planning

Route Setting

Before planning, we recommend setting the global parameters for the flight route first to increase planning efficiency. For example, if the global "Shooting Distance" is set at 3 m, the distance between the aircraft and the shooting location will be automatically adjusted to 3 m during the creation of any subsequent inspection point. The specific steps are as follows:

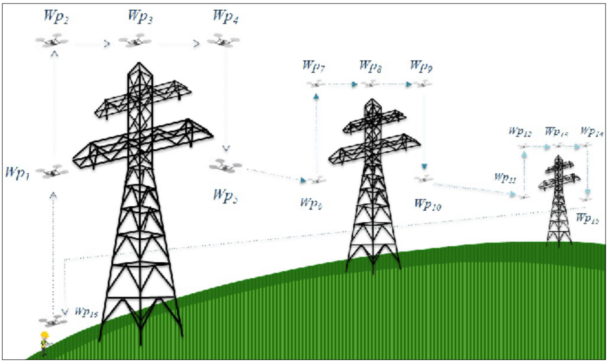
1. **Aircraft yaw:** We recommend using "Set Waypoint Separately". Selecting waypoints in the direction of the route may increase the aircraft's yaw rotation time, thus lowering inspection efficiency.
2. **Finishing Action:** Defines the action executed by the aircraft when the mission is completed. When "Return to Home" is active, the return altitude and logic will follow the parameter settings in the app.

3. **Photo Ratio:** Apply default setting.
4. **Shooting Distance:** If a shooting distance has been set in “Flight Route Settings”, it automatically overwrites the shooting distance for every waypoint in “Waypoint Settings”. You may reset each waypoint as needed in “Waypoint settings”.
5. **Flight Route Speed:** The aircraft’s flight speed when executing a mission on a flight route. If a flight speed has been set in “Flight Route Settings”, it automatically overwrites the flight speed for every waypoint in “Waypoint Settings”. You may reset each waypoint as needed in “Waypoint settings”.
6. **Initial Speed:** The aircraft’s speed upon reaching its first waypoint and during its return after completing the mission. This can be set by you.
7. **Safety Distance:** The Safety Distance between the flight route and the model. When the distance between a flight route section and the model is shorter than the set Safety Distance, the section will appear red and show the shortest distance between the flight route and model.



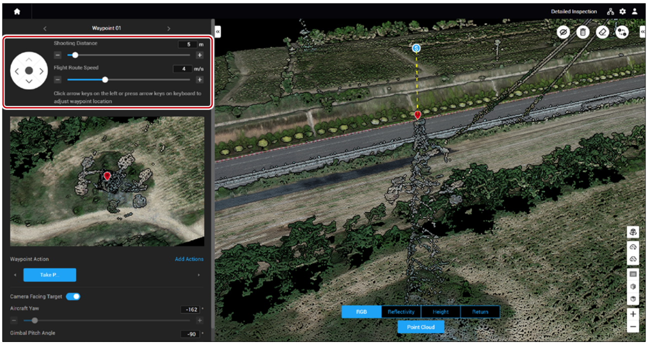
Inspection Waypoint Settings

Flight routes involving power lines and transmission towers can vary widely. You can plan the route according to factors such as shooting order, efficiency, and flight safety. This example below is based on the inspection method for cat-head type towers described in the “Drone Photography Manual for Inspection of Overhead Transmission Towers (Sealed Version)”.



1. **Preparation:** DJI Terra's Detailed Inspection feature can simulate the images seen by the aircraft. After adjusting the POV with your cursor, left-click a shooting location to create a waypoint, which will be automatically generated based on the parameters, shooting angles and other information in "Global Settings". To modify a waypoint, you can select it (which will turn blue) and then adjust its location, shooting distance, and flight speed.

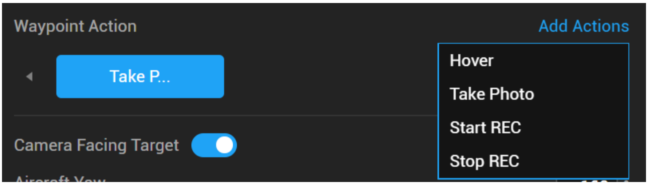
   A waypoint's location can be adjusted with the "up", "down", "left", and "right" keys on the keyboard, or by dragging a blue waypoint or red location point. To switch between two adjacent waypoints, click "<" or ">" or press "Ctrl+ ← " or "Ctrl+ → " on the keyboard.



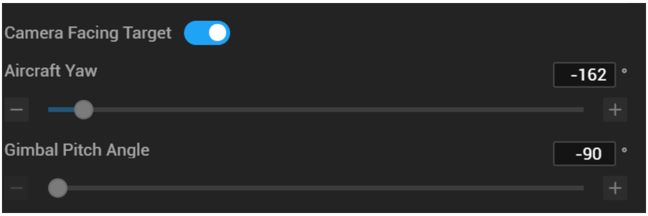
2. **Setting the Entry Point:** Before starting an inspection mission, set an entry point to ensure your aircraft is placed at a preset location and can enter the inspection route safely. Therefore, an entry point should preferably be a more conspicuous location (example: a central location facing the transmission tower), so that the pilot can easily judge whether the aircraft's correctly located.

(A conspicuous entry point makes it easier for the pilot to judge the aircraft’s location.

3. **Setting Inspection Waypoints:** According to inspection requirements, inspection waypoints should cover the entire tower, tower head, tower body, base, voltage transmitter and receiver points, insulators, left insulator and hanging point, middle insulator and hanging point, and right insulator and hanging point.
   a. Each inspection waypoint will automatically include a “Take Photo” waypoint action. You can add or remove any waypoint action if it is an entry or exit point or if you have other requirements.

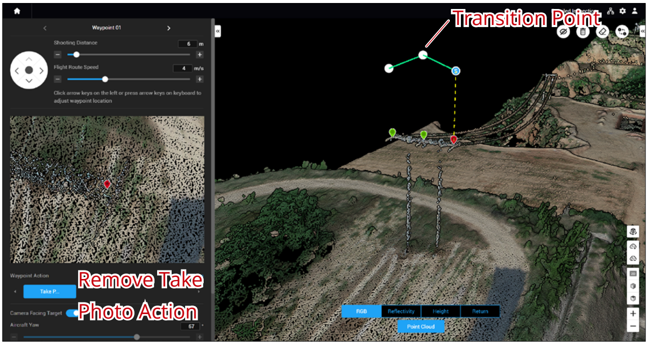


   b. “Camera Facing Target” is automatically enabled for every inspection waypoint, to ensure the aircraft places the target at the center of the image. You can disable the feature manually and set custom aircraft yaw and gimbal pitch angles.



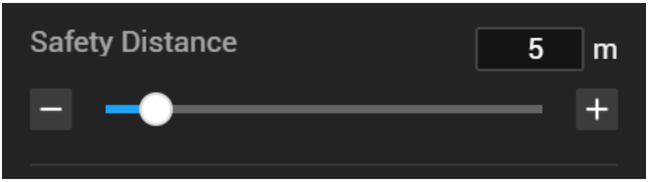
c. If you are using a Matrice 300 RTK mounted with a H20 series payload, “Zoom” can also be set for each waypoint for easier optical zoom adjustment. While adjusting “Zoom”, DJI Terra can simulate changes on the aircraft image.

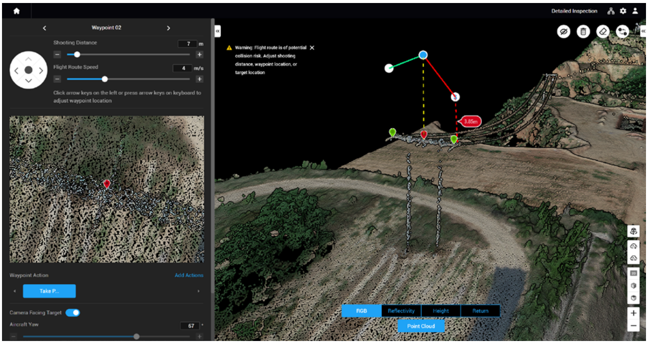
4. **Setting Transition Points:** Since the flight route between any two waypoints is linear, transition points must be added in order to avoid collision risk. They are often added at corners or turning points. As transition points are only for adjusting the aircraft’s flight attitude, you can remove “Take Photo” from their waypoint actions.



Flight Route Safety Check

By setting the "Safety Distance", you can judge whether a flight route has any risk of collision. The flight route will appear green if it is safe. However, when the distance between a flight route section and the model is shorter than the set safety distance, the section will appear red and show the shortest distance between the flight route and model. In the example below, assuming the safe distance is 1.5 m, DJI Terra is automatically judging whether this flight route section has any collision risk. A warning alert appears on the top left corner of the interface, while the locations and values with the shortest distance are marked in red (the distance being 1.45 m in this example). When this happens, you should adjust the corresponding waypoint locations on that section to bring them within the safety distance.

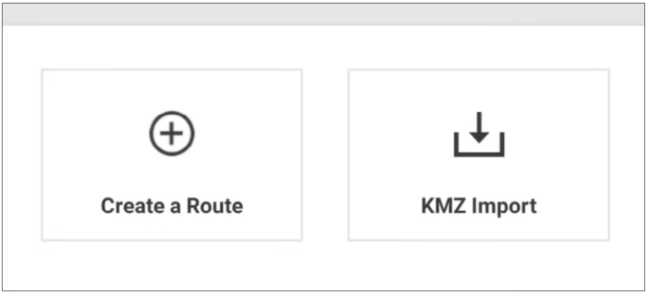




Route Export and Execution

After you complete planning the route and setting the parameters, save the mission. Click the "Export KML" icon on the top right corner of the interface to export the KML flight route mission and save it in the designated folder. The exported KML flight route file can be imported into the DJI Pilot app to perform a flight.

1. Open the DJI Pilot app, select "Flight Mission", click "Import KML" and "Waypoint Flight", then find the KML file exported from DJI Terra in the corresponding directory.

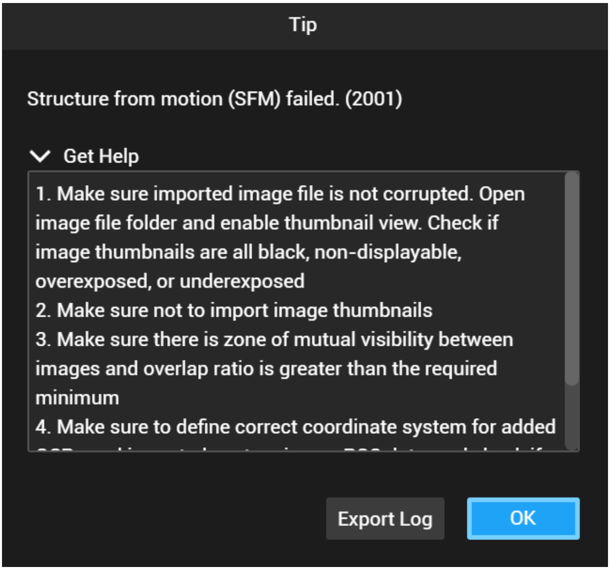


2. After loading the relevant mission, check the waypoint parameters again before clicking the icon on the left to upload the flight route and execute the inspection mission.

⚠ The aircraft model number for the detailed inspection settings must be the same as the actual aircraft being used, otherwise the simulated preview and actual shot images would differ, thus affecting the inspection effects.

Appendix - Error Alerts and Operating Suggestions

If an error is reported, DJI Terra will provide corresponding assistance. Most issues can be resolved by following the guide. You may also look up the error code in the attached table to search for a solution.



For an issue that cannot be resolved, click “Export Log” to save the mission’s log and send it to the relevant aftersales personnel for troubleshooting.

DJI Terra - Reconstruction Error Alerts and Operating Suggestions (Updated)

Error Code	Error Alert	Operating Suggestion
		General
0001	No usage permission for this function	1. Use the license containing this feature.
0004	NVIDIA graphics card (4GB or above) required	1. Check if graphics card of your computer meets the requirements.
1001	License error	1. Check if license is bound successfully. 2. Make sure license is within validity period.
1002	JSON file read error	1. Check task JSON file input and make sure each keyword is completely consistent with sample document and all necessary fields exist. 2. Check message prompt of last output of log file.

1003	NVIDIA graphics card not detected	1. If error prompt appears at beginning of reconstruction, check if graphics card of your computer meets the requirements. Refer to DJI Terra FAQ Purchase and Preparation for Computer Configuration Requirements). If graphics card meets the requirements, download graphics card driver from NVIDIA's official website and upgrade it to latest version. 2. If error prompt appears after reconstruction had started for a period of time, create a region of interest to remove edge region and try reconstruction again.
1004	DMV file read error	1. Try aerotriangulation again.
1005	File or file folder creation error	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory and local temporary directory of worker device are located.
1007	Aerotriangulation block splitting error. Check available RAM or reduce distance from ground to camera/subjects	1. Check available RAM or reduce Distance to Ground/ Subject.
2001	Aerotriangulation computation failed	1. Make sure imported image file is not corrupted. Open image file folder and enable thumbnail view. Check if image thumbnails are all black, non-displayable, overexposed, or underexposed. 2. Make sure not to import image thumbnails. 3. Make sure there is zone of mutual visibility between images and overlap ratio is greater than the required minimum. 4. Make sure to define correct coordinate system for added GCPs and imported custom Image POS Data, and check if GCP marks, ordering of latitude and longitude, POS accuracy, and control point accuracy are correct (the accuracy cannot be 0.0).
2002	Distortion correction error	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located.
2003	Point cloud generation error	1. Check if graphics card has a memory greater than 4 GB. 2. Create a region of interest to remove edge region and try reconstruction again.

2004	Network reconstruction failed	1. Check if there is sufficient space available in disk where cache directory and shared directory for cluster reconstruction are located. 2. Create a region of interest to remove edge region and try reconstruction again.
2005	Scene divide error	1. Create a region of interest to remove edge region and try reconstruction again.
2006	LOD error	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory and local temporary directory of worker device are located. 3. Create a region of interest to remove edge region and try reconstruction again.
2007	MVS error	1. Check if there is sufficient space available in disk where cache directory is located. 2. Create a region of interest to remove edge region and try reconstruction again. 3. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located. 4. Check if graphics card has a memory greater than 4 GB. 5. Refer to DJI Terra Quality Report for Aerotriangulation and check whether optimized intrinsic camera parameters are significantly different from the initial.
2008	Failed to generate XML file	1. Make sure image data is within coverage of XML output coordinate system.
3001	Semantic identification error	1. Check if graphics card has a memory greater than 4 GB.
3002	Digital Surface Model (DSM) generation failed	1. Open Task Manager and check memory usage. End tasks that occupy too much memory. 2. Check if there is sufficient space available in disk where cache directory is located.
3003	Orthorectification failed	1. Check if there is sufficient space available in disk where cache directory is located.
3004	Orthophoto mosaic failed	1. Check if there is sufficient space available in disk where cache directory is located.

3005	Generating map tile failed	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located. 3. Create a region of interest to remove edge region and try reconstruction again.
3006	Generating 2D map report failed	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located.
3007	Writing image failed	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located.
3008	Projecting reconstruction output failed	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located. 3. The region where reconstruction data is located is not within coverage of the set projected coordinate system.
3009	Invalid image data	1. Make sure vertical gimbal angle is greater than 15° (35° for v3.1.0 and later versions). 2. If image data is not of above type, check aerotriangulation result. Try the following steps if there is error in aerotriangulation output: a. Make sure imported image file is not corrupted. Open image file folder and enable thumbnail view. Check if image thumbnails are all black, non-displayable, overexposed, or underexposed; b. Make sure not to import image thumbnails; c. Make sure there is zone of mutual visibility between images and overlap ratio is greater than the required minimum; d. Make sure to define correct coordinate system for added GCPs and imported custom Image POS Data, and check if GCP marks, ordering of latitude and longitude, POS accuracy, and control point accuracy are correct (the accuracy cannot be 0.0).

3010	Preprocessing image failed	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory is located.
4002	Insufficient memory	1. Open Task Manager and check memory usage. End tasks that occupy too much memory 2. Create a region of interest to remove edge region and try reconstruction again. 3. For LiDAR point cloud processing, reduce point cloud density and try again or adjust point cloud effective distance to save resources used for processing invalid regions.
4003	Insufficient graphics card memory	1. Open Task Manager and check graphics card memory usage. End tasks that occupy too much memory. 2. Create a region of interest to remove edge region and try reconstruction again.
5001	Output coordinate system error	1. Check if coordinate system is set correctly. 2. If image does not contain POS information, you are unable to set known coordinate system for output. 3. Make sure to set arbitrary coordinate system for output if GCPs from arbitrary coordinate system are added. 4. Custom PRJ file contains special elevation system not supported by DJI Terra at the moment. 5. The region where reconstruction data is located is not within coverage of the set elevation system.
5002	Quality Report export error	1. Check if mission folder and report folder where quality report is stored have write permission enabled.
6001 / 6002	Error	1. Check if there is sufficient space available in disk where cache directory is located. 2. For cluster reconstruction, check local area network connection and if there is sufficient space available in disk where shared directory and local temporary directory of worker device are located.
LiDAR Point Cloud Reconstruction		
8001	Original data missing LDR type file or file path error	1. Check if original data is missing LDR type file.
8002	CLI file missing in original data or file path error	1. Check if original data is missing CLI type file.

8007	POS data error. Check base station data and RTK data, and perform calibration flight before and after data collection.	1. Check if base station data and RTK data are missing. 2. Perform calibration flight before and after data collection.
8008	Optimizing LiDAR point cloud accuracy failed	1. Increase overlap ratio of collected data and process data again.
8009	File read and write error	1. Check if there is sufficient space available in disk where cache directory is located.
8010	CLC file missing in original data or file path error	1. Check if CLC file is missing in original data.
8012	Zenmuse L1 calibration failed. Insufficient number of images in original data	1. Make sure to import at least 4 images.
8015	Zenmuse L1 calibration failed. Different device data or several subfolders in the same imported folder currently not supported	1. Different device data or several subfolders in the same imported folder currently not supported.
8020	Parsing base station data file to RENIX format error	1. Contact DJI Support for assistance.
8022	Attitude initialization failed	1. Make sure to perform calibration flight before and after data collection
8027	Optimizing LiDAR point cloud accuracy failed	1. Increase overlap ratio of collected data and process data again.
8028	File read and write error	1. Check if there is sufficient space available in disk where cache directory is located.
8029	File path error or CLC file missing in original data	1. Check if CLC file is missing in original data.
8030	Original data CLC file format error	1. Check if CLC file is missing in original data.
8031	Zenmuse L1 calibration failed. Insufficient number of images in original data	1. Make sure to import at least 3 images.

8102	Base station data file missing in original data. Check if any of the following files are missing: RTB, OEM, RINEX, RTCM 3, and UBX	1. Check if any of the following files are missing: RTB, OEM, RINEX, RTCM 3, and UBX.
8104	RTK file missing in original data or file path error	1. Check if RTK file is missing in original data.
8108	Parsing base station data file failed. Make sure file is in one of the following formats: RTB, OEM, RINEX, RTCM 3, or UBX	1. Check if base station file is in one of the following formats: RTB, OEM, RINEX, RTCM 3, and UBX.
8122	IMU file missing in original data or file path error	1. Check if IMU file is missing in original data.
8124	RTL file missing in original data or file path error	1. Check if RTL file is missing in original data.
8133	Attitude initialization failed. Make sure to perform calibration flight before and after data collection	1. Make sure to perform calibration flight before and after data collection.
Cluster Reconstruction		
1006	JPEG required for reconstruction	1. Unable to sync original images. Check local area network connection and if there is sufficient space available in disk where shared directory is located.
7001	No available worker device	1. Make sure worker devices on local area network are enabled and available. 2. Refresh worker device list in cluster reconstruction device list of control device. Make sure that worker devices can be searched, then select devices and apply for reconstruction. 3. If firewall is enabled, make sure that DJIPicMapGen.exe has access to local area network (LAN) in firewall settings.
7002	Unable to visit control device shared directory. Check device connection	1. Check local area network connection and make sure control device has access to shared directory.
7003	Worker device disconnected	1. Check and make sure local area network connection is stable. Replace network cable if issue recurs frequently.

7004	File folder not found	1. Check if shared directory set by control device is accessible for worker devices. Mapped drive letter path is not available at the moment.
7005	Unable to write file folder	1. Check if shared folder has write permission enabled.
7703	Port for searching worker device error	1. Check if control device has write permission for shared directory.

If issue cannot be solved, contact DJI Support.

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If you have any questions about this document, please contact DJI by sending a message to: **DocSupport@dji.com**