



TUTORIAL

AERIAL IMAGE PROCESSING



X-PHOTO Aerial

DESCRIPTION

- Create Point Cloud from Images
- Create DSM, Orthophoto and 3D Surface from Point Cloud
- Stereo Drawing Tool

GOAL

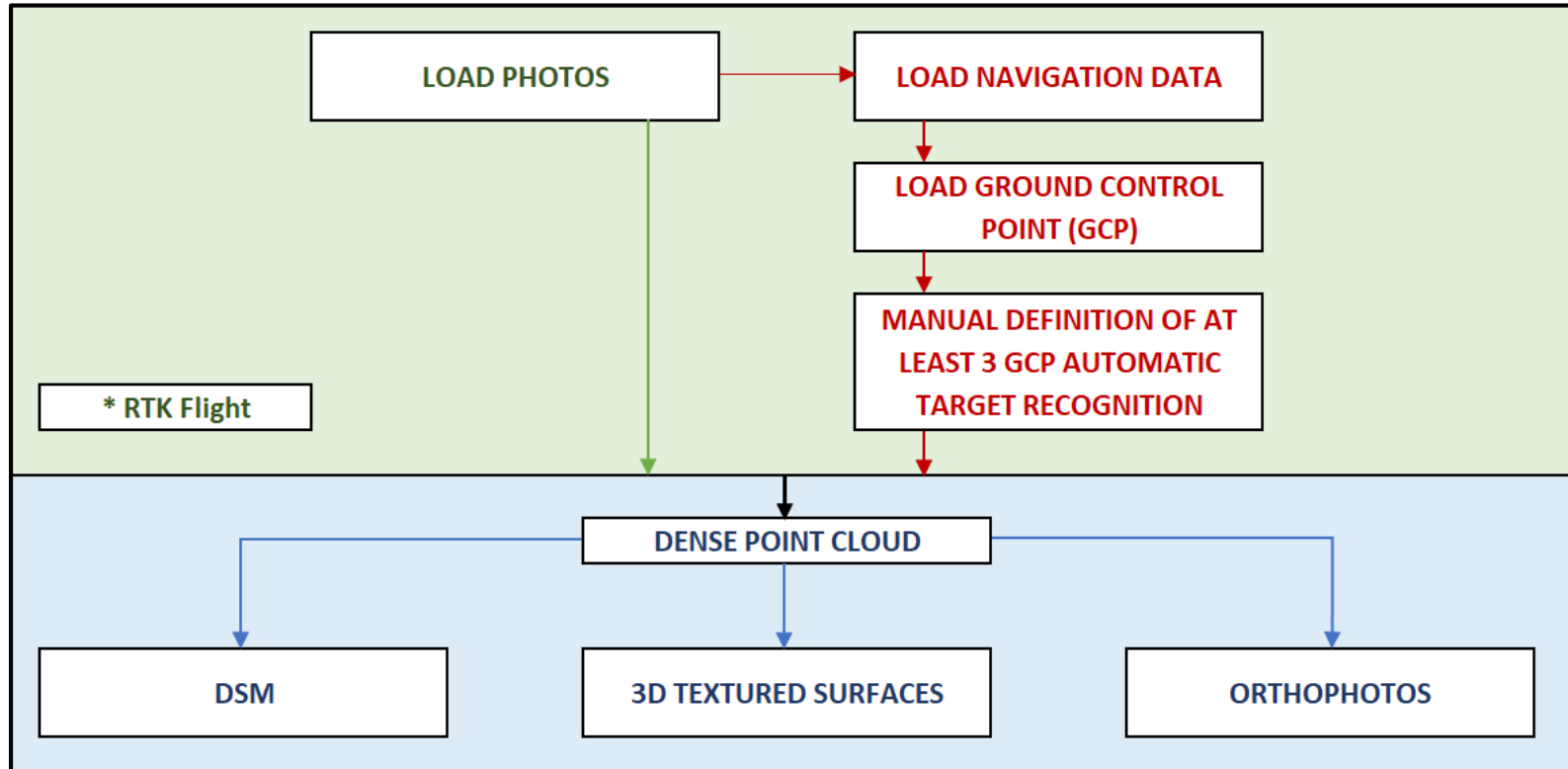
- Import and manage data to create Point Clouds and elaboration from images

DATA

- X-PHOTO AERIAL.gfdoff
- Aerial Images Folder



X-PHOTO Aerial



(*) With RTK flight we can process data with 1, 2, 3,... or even without GCP. The GCPs are displayed directly on the estimated position





X-PHOTO Aerial

GROUND CONTROL POINT – GCP

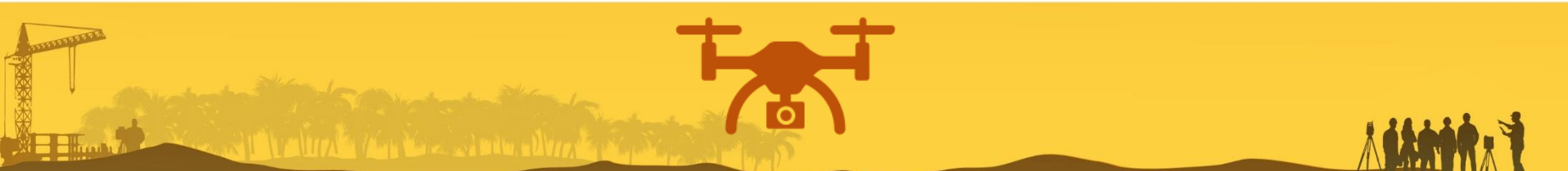
Points on the ground with known coordinates. During the aerial photographs survey it is possible to use visible markers or targets and determinate the position with a topographic survey.

SPARSE CLOUD

It represents the Point Cloud created by the general alignment of the images used. It shows the Camera Orientation result.

DENSE CLOUD

It represents the complete Point Cloud created by the advanced calculation based on the images alignment and the ground control points used





X-PHOTO Aerial

GRAPHIC PROCESSING UNIT - GPU

It is part of the graphic card which performs rapid mathematical calculation. It is possible to use a dedicated GPU to improve Dense Cloud calculation

DIGITAL SURFACE MODEL – DSM

It represents a digital 3D surface model which includes all the elements, natural and man-made structure (i.e. vegetation, buildings, bridges..)

SOLID ORTHOPHOTO

It represents the typical 2D raster orthophoto that automatically associates to each pixel a georeferenced height.

STEREO DRAWING

It represents an advanced drawing tools based on analytical photogrammetry process. It is possible to use the Stereo Drawing function for the manual computation of coordinates in 3D space.

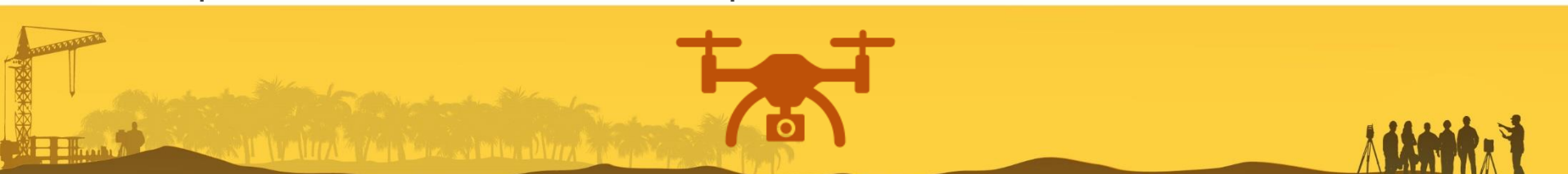

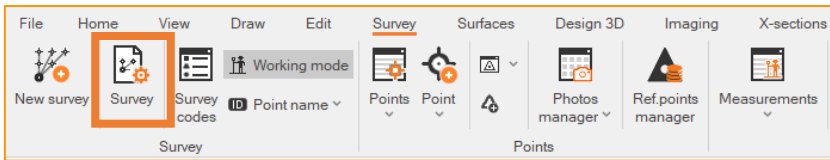


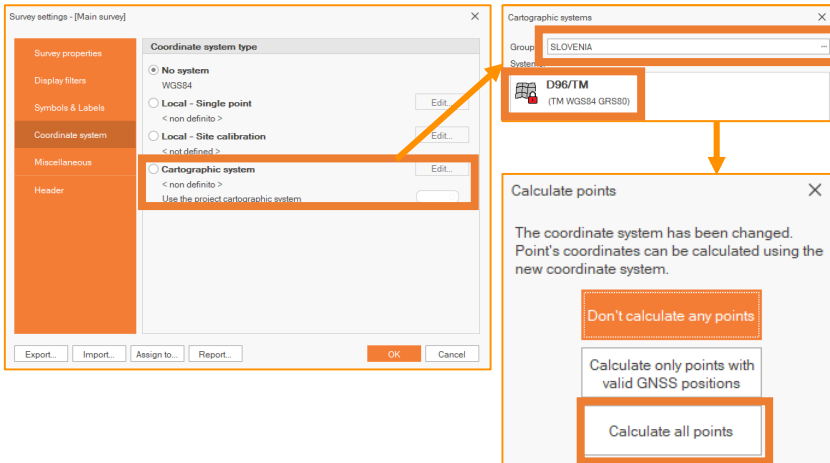
Image Processing Project

Name	Type
 X-PHOTO AERIAL	XPad.Office.Fusion Document
<input type="checkbox"/> X-PHOTO AERIAL.gfd_bak	GFD_BAK File

From Image_Processing folder open Fusion project: **X-PHOTO AERIAL.gfdoff**



From Survey menu it is possible to select **Survey** option and from Survey Settings menu select the submenu Coordinate system – **Cartographic system**.



From default Cartographic System select **Slovenia D96/TM**

From Calculation points select **Calculate all points**

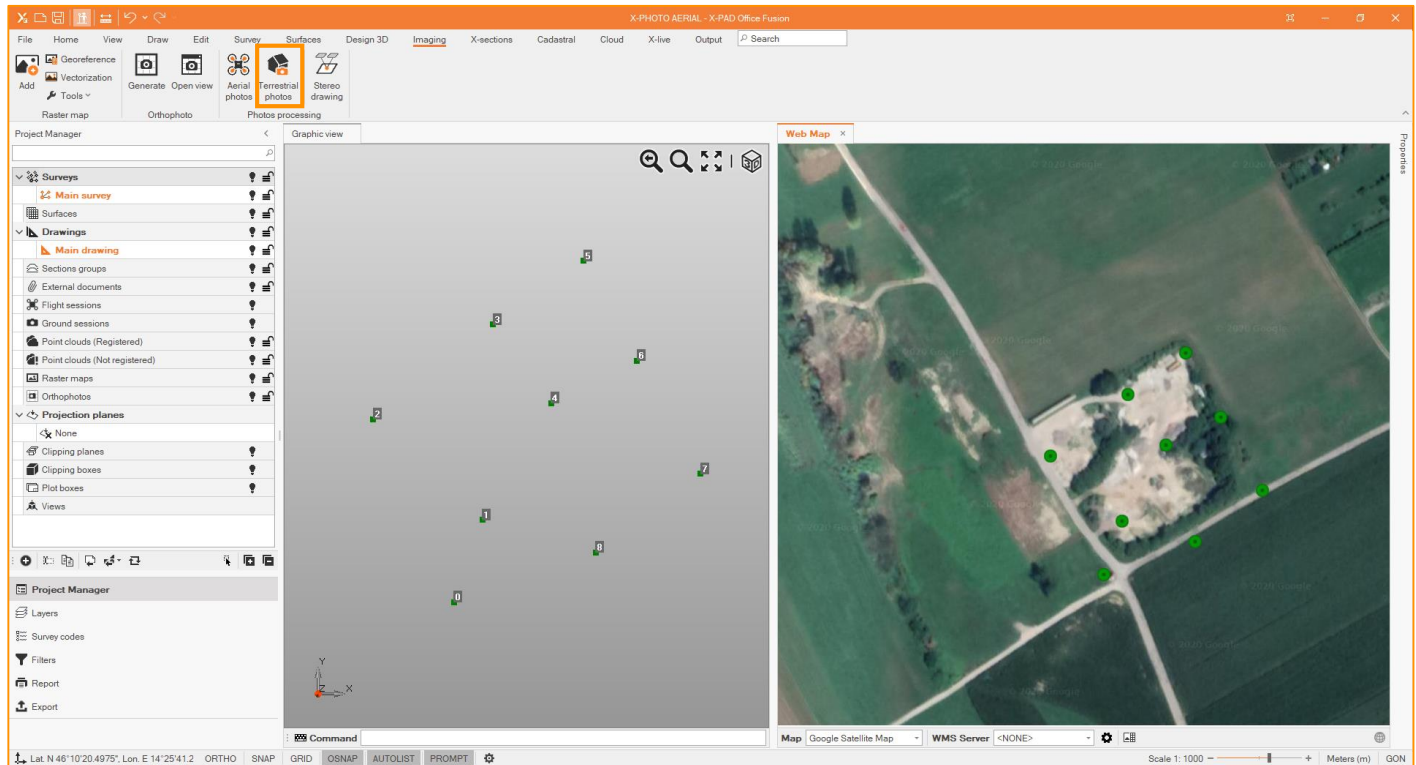
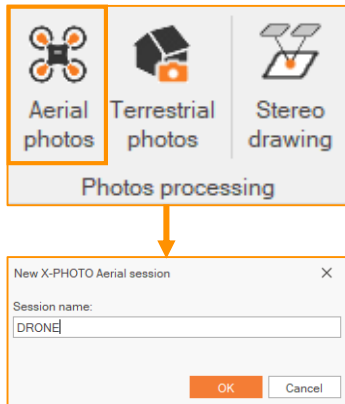


Photo Processing

Imaging Menu



PHOTO PROCESSING is available from Imaging menu, select **Aerial photo** and enter **Session Name**



Starting
Data

Camera
Orientation

GCP

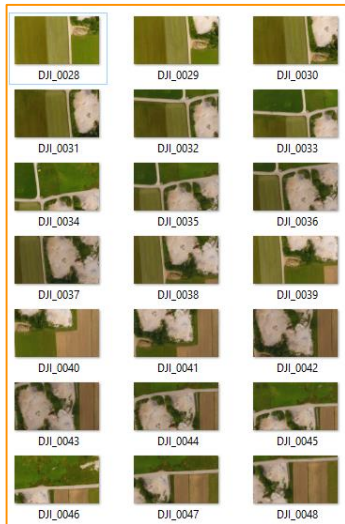
Optimise
Orientation

Elaborations



Aerial Photo Processing Images

Use **Aerial Images** folder to load photos from which it is possible to visualize camera parameters and navigation data



X-PHOTO processing manager

STARTING DATA CAMERA ORIENTATIONS 3D RECONSTRUCTION

View: Photos Navigation Ground Control Points Coordinate system: D96TM (TM WGS84 GRS80) Tools: Camera parameters Settings

Use	Name	Size	Date
<input checked="" type="checkbox"/>	DJI_0035.JPG	3.9 Mbytes	6/8/2016 10:41:44 A.
<input checked="" type="checkbox"/>	DJI_0036.JPG	3.9 Mbytes	6/8/2016 10:41:47 A.
<input checked="" type="checkbox"/>	DJI_0037.JPG	3.9 Mbytes	6/8/2016 10:41:50 A.
<input checked="" type="checkbox"/>	DJI_0038.JPG	3.7 Mbytes	6/8/2016 10:41:53 A.
<input checked="" type="checkbox"/>	DJI_0039.JPG	3.8 Mbytes	6/8/2016 10:41:56 A.
<input checked="" type="checkbox"/>	DJI_0040.JPG	3.9 Mbytes	6/8/2016 10:42:09 A.
<input checked="" type="checkbox"/>	DJI_0041.JPG	4.0 Mbytes	6/8/2016 10:42:13 A.
<input checked="" type="checkbox"/>	DJI_0042.JPG	3.9 Mbytes	6/8/2016 10:42:16 A.
<input checked="" type="checkbox"/>	DJI_0043.JPG	3.9 Mbytes	6/8/2016 10:42:19 A.
<input checked="" type="checkbox"/>	DJI_0044.JPG	3.8 Mbytes	6/8/2016 10:42:22 A.
<input checked="" type="checkbox"/>	DJI_0045.JPG	4.1 Mbytes	6/8/2016 10:42:25 A.
<input checked="" type="checkbox"/>	DJI_0046.JPG	4.2 Mbytes	6/8/2016 10:42:37 A.

Photo

Used

File name	DJI_0036.JPG
Date	6/8/2016 10:41 AM
Size	3.9 Mbytes
Width (px)	4000
Height (px)	2250
Res. horizontal	72
Res. vertical	72

Lens parameters

Producer	DJI
Model	FC330
Focal length (mm)	3.6
Focal length eq. 35mm (mm)	20.0
Field of view	93.0g

Exposure settings

Exposure time	1/688 s
Aperture	f 3.0
ISO	100

GNSS position

Latitude	N 46°10'14.9321"
Longitude	E 14°25'34.6113"
Altitude	379.810m

Total: 44 Used: 44 Registered: -

Map: Google Satellite Map WMS Server: <NONE>

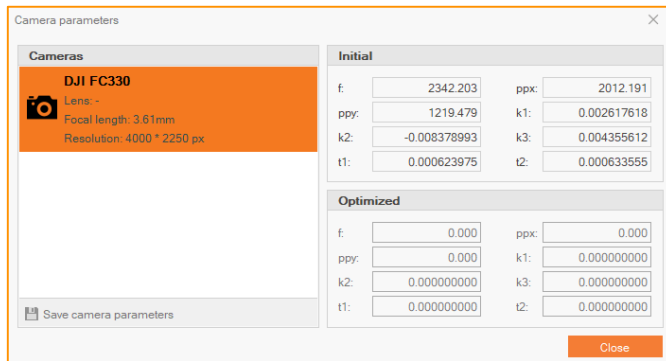
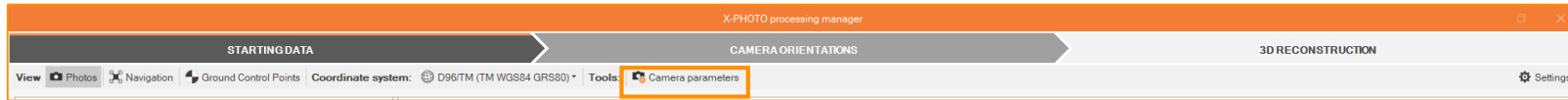
Other images formats are:
JPG, BMP, PNG



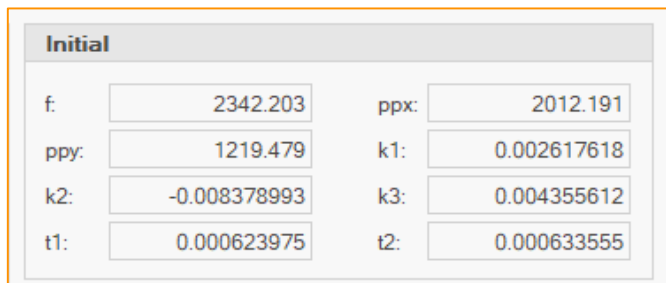
Starting Data

Aerial Photo Processing

Images - Camera Parameters



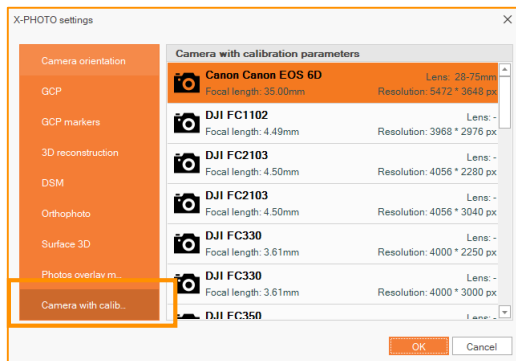
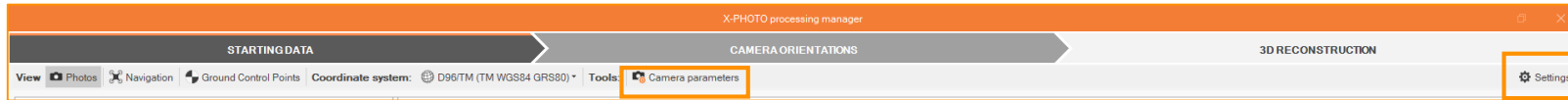
If the camera used is already in our list of camera with calibration parameters, from **Starting Data** menu it is possible to select **Camera parameters** and check the initial parameters for the current camera.



k1, k2, k3: radial distortion
t1, t2: tangential distortion
ppx, ppy: principal point x and y (pixels refers to image angles)
f: focal length



Aerial Photo Processing Images - Camera Parameters



From main menu select **Settings**, then click on **Camera with calibration parameters** to check the camera's list.

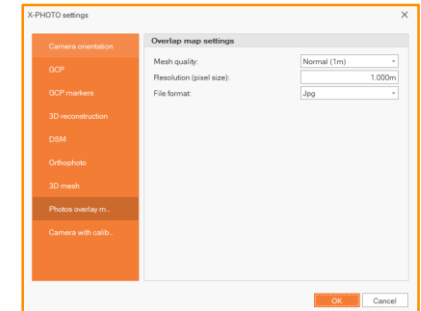
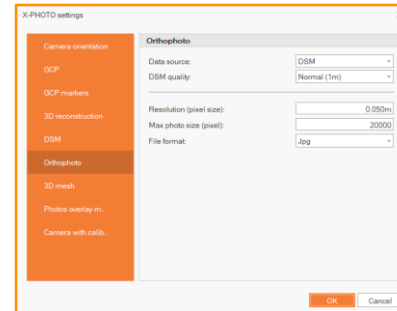
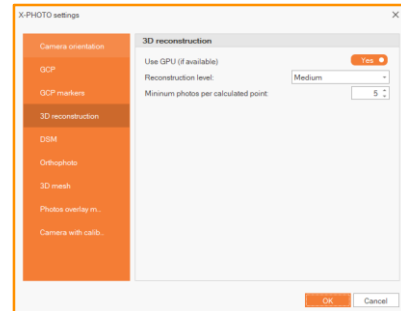
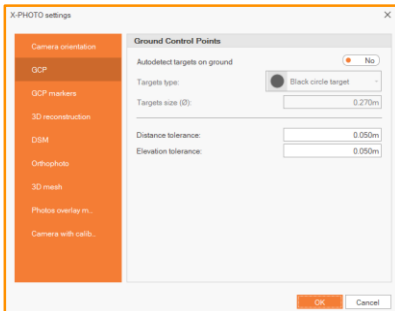
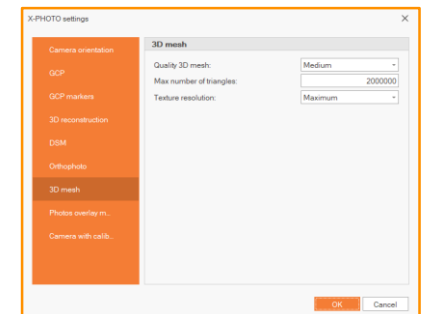
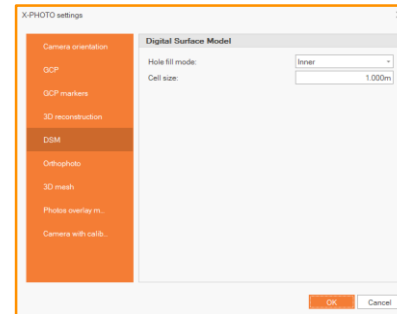
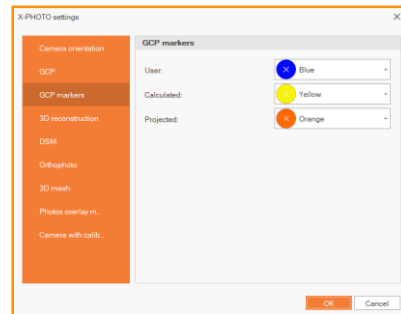
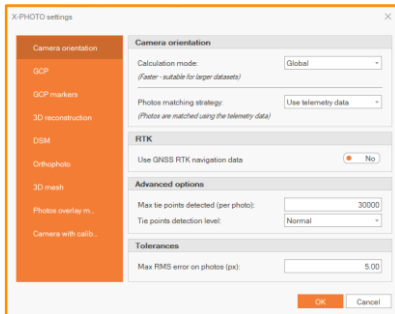
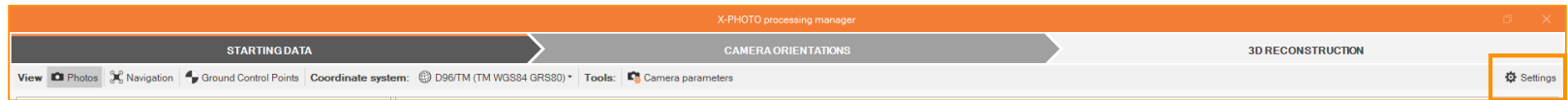
If the camera used is not in the list it's possible to continue with elaboration and create a customized profile for the camera



Starting
Data

Aerial Photo Processing Settings

From main menu click on **Settings** to set the default parameters for each X-Photo menu and tools



Aerial Photo Processing

Navigation Data

Load of **Navigation Data** whenever is possible; drones equipped with RTK GNSS receiver are also supported; in this case “one click” to get the final result.

X-PHOTO processing manager

STARTING DATA CAMERA ORIENTATIONS 3D RECONSTRUCTION

View Photos **Navigation** Ground Control Points Coordinate system: D961M (TM WGS84 GRS80) Tools: Camera parameters Settings

Photo name	Latitude	Longitude	Altitude	Relative alt.	Flight yaw	Flight pitch	Flight
DJI_0028.JPG	N 46°10'15.0208"	E 14°25'38.8930"	380.210m	80.200m	-135.1111g	-20.2222g	
DJI_0029.JPG	N 46°10'14.7194"	E 14°25'38.1029"	379.710m	79.700m	-132.8889g	-12.2222g	
DJI_0030.JPG	N 46°10'14.3618"	E 14°25'37.2001"	379.810m	79.800m	-133.2222g	-13.7778g	
DJI_0031.JPG	N 46°10'14.0124"	E 14°25'36.3119"	379.810m	79.800m	-133.3333g	-12.0000g	
DJI_0032.JPG	N 46°10'13.6659"	E 14°25'35.4272"	380.010m	80.000m	-133.2222g	-11.6667g	
DJI_0033.JPG	N 46°10'13.3176"	E 14°25'34.5369"	380.110m	80.100m	-133.2222g	-11.2222g	
DJI_0034.JPG	N 46°10'14.2887"	E 14°25'32.8712"	379.910m	79.900m	-134.1111g	11.7778g	
DJI_0035.JPG	N 46°10'14.5718"	E 14°25'33.6966"	379.910m	79.900m	-133.0000g	9.2222g	
DJI_0036.JPG	N 46°10'14.9321"	E 14°25'34.6113"	379.810m	79.800m	-133.2222g	9.7778g	
DJI_0037.JPG	N 46°10'15.2821"	E 14°25'35.5026"	379.810m	79.800m	-133.3333g	9.8889g	
DJI_0038.JPG	N 46°10'15.6352"	E 14°25'36.3988"	380.110m	80.100m	-133.3333g	8.7778g	
DJI_0039.JPG	N 46°10'15.9850"	E 14°25'37.2932"	380.110m	80.100m	-133.1111g	9.2222g	
DJI_0040.JPG	N 46°10'17.4512"	E 14°25'36.8436"	380.610m	80.600m	-131.2222g	-4.1111g	
DJI_0041.JPG	N 46°10'17.0545"	E 14°25'35.9572"	379.710m	79.700m	-133.3333g	-12.0000g	
DJI_0042.JPG	N 46°10'16.6935"	E 14°25'35.0489"	379.810m	79.800m	-133.0000g	-12.5556g	
DJI_0043.JPG	N 46°10'16.3437"	E 14°25'34.1550"	380.010m	80.000m	-133.3333g	-13.0000g	
DJI_0044.JPG	N 46°10'15.9944"	E 14°25'33.2618"	379.910m	79.900m	-133.2222g	-12.2222g	
DJI_0045.JPG	N 46°10'15.6442"	E 14°25'32.3686"	379.810m	79.800m	-133.2222g	-12.6667g	
DJI_0046.JPG	N 46°10'16.7041"	E 14°25'30.8980"	380.410m	80.400m	-132.5556g	-0.2222g	
DJI_0047.JPG	N 46°10'17.0547"	E 14°25'31.9272"	379.810m	79.800m	-133.4444g	8.3333g	
DJI_0048.JPG	N 46°10'17.2946"	E 14°25'32.5389"	379.810m	79.800m	-133.2222g	7.8889g	
DJI_0049.JPG	N 46°10'17.6462"	E 14°25'33.4331"	380.010m	80.000m	-133.2222g	9.5556g	
DJI_0050.JPG	N 46°10'17.9961"	E 14°25'34.3249"	379.910m	79.900m	-133.2222g	9.0000g	
DJI_0051.JPG	N 46°10'18.3493"	E 14°25'35.2195"	380.010m	80.000m	-133.2222g	9.6667g	
DJI_0053.JPG	N 46°10'17.0601"	E 14°25'30.7607"	361.670m	59.500m	65.3333g	-10.5556g	
DJI_0055.JPG	N 46°10'17.7073"	E 14°25'32.4029"	362.070m	59.900m	65.4444g	-8.4444g	
DJI_0057.JPG	N 46°10'18.3563"	E 14°25'34.0071"	362.070m	59.900m	65.3333g	-6.6667g	
DJI_0059.JPG	N 46°10'19.0044"	E 14°25'35.6148"	361.770m	59.600m	65.4444g	-9.7778g	
DJI_0061.JPG	N 46°10'17.8303"	E 14°25'35.9040"	361.770m	59.600m	65.6667g	11.0000g	
DJI_0063.JPG	N 46°10'17.1803"	E 14°25'34.2729"	362.170m	60.000m	65.5556g	8.1111g	
DJI_0065.JPG	N 46°10'16.6437"	E 14°25'32.9393"	362.070m	59.900m	65.6667g	8.1111g	
DJI_0067.JPG	N 46°10'15.9985"	E 14°25'31.3346"	362.170m	60.000m	65.6667g	9.3333g	
DJI_0069.JPG	N 46°10'15.1329"	E 14°25'32.3757"	361.970m	59.800m	65.4444g	-8.8889g	
DJI_0071.JPG	N 46°10'15.7857"	E 14°25'34.0070"	362.070m	59.900m	65.5556g	-0.2222g	

Start: 10:41:11 End: 10:55:31 Duration: 00:14:20 Distance: 1411.034m

Map Google Satellite Map WMS Server <NONE>

Starting Data



Aerial Photo Processing

Ground Control Points

Load of Ground Control Point (GCP) and Check points; X-PAD Fusion topographic points can be use

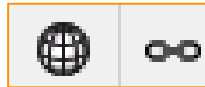
STARTING DATA		CAMERA O			
View: Photos Navigation		Ground Control Points Coordinate system: D96/T			
Use	Name	X	Y	Z	
GCP	0	455681.308m	114696.481m	350.129m	
GCP	1	455691.808m	114726.560m	349.918m	
GCP	2	455651.716m	114763.407m	349.847m	
GCP	3	455695.583m	114797.998m	347.287m	
GCP	4	455716.940m	114769.275m	346.391m	
GCP	5	455728.879m	114821.316m	349.891m	
GCP	6	455748.372m	114784.834m	349.622m	
GCP	7	455771.720m	114743.370m	349.659m	
GCP	8	455733.267m	114714.664m	349.754m	



Use this function to import GCP as **TXT** and **CSV**



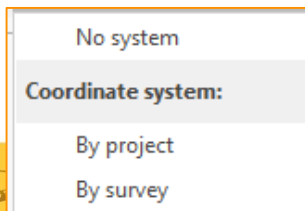
Use this function to import GCP from X-Pad Fusion's **Survey**



Use this functions to **Delete** or change point's View



It is possible to select this function to define a Coordinate System, if it has not been previously selected



Using the Coord System manager it is possible to define the cartographic system

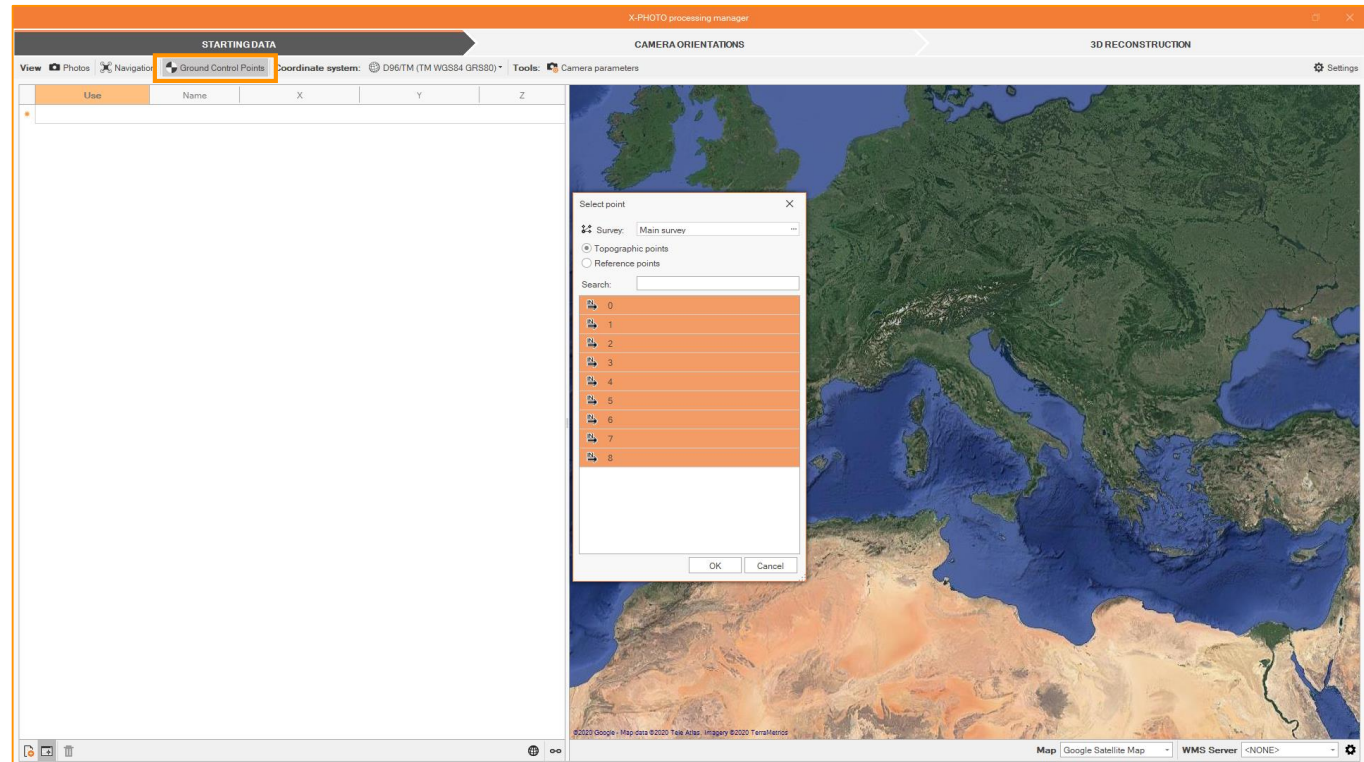
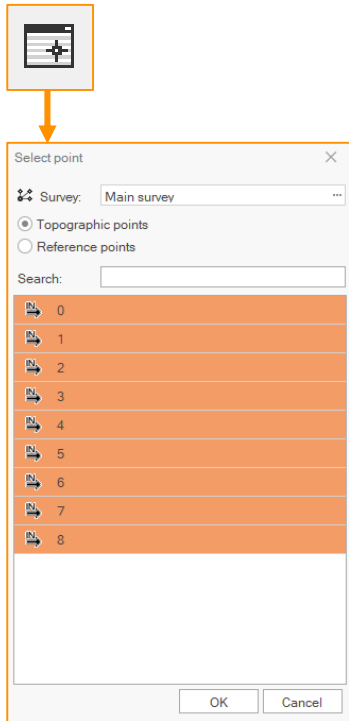
Starting Data



Aerial Photo Processing

Ground Control Points

Load of **Ground Control Point (GCP)** and Check points; X-PAD Fusion topographic points can be used



Starting
Data



Aerial Photo Processing

Ground Control Points



Load of Ground Control Point (GCP) and Check points; X-PAD Fusion topographic points can be used

The screenshot shows the 'X-PAD PHOTO processing manager' interface. The 'GROUND CONTROL POINTS' tab is selected, displaying a table of 8 GCPs. The table has columns for 'Use', 'Name', 'X', 'Y', and 'Z'. The 'Use' column is set to 'GCP' for all entries. The 'Name' column is empty. The 'X', 'Y', and 'Z' columns contain coordinates in meters. The 'Z' column values are consistently around 349m. The aerial photo on the right shows 8 ground control points marked with black and white crosshair symbols on a terrain. The interface also shows 'STARTING DATA', 'CAMERA ORIENTATIONS', 'OPTIMISE ORIENTATION', and '3D RECONSTRUCTION' tabs. The 'Coordinate system' is set to 'D96(TM (TM WGS84 GRS80))' and 'Tools' is set to 'Camera parameters'.

Use	Name	X	Y	Z
GCP		455681.308m	114696.481m	350.129m
GCP	1	455691.808m	114726.560m	349.918m
GCP	2	455651.716m	114783.407m	349.847m
GCP	3	455695.583m	114797.998m	347.287m
GCP	4	455716.940m	114769.275m	346.391m
GCP	5	455728.876m	114821.316m	349.891m
GCP	6	455748.372m	114784.834m	349.822m
GCP	7	455771.720m	114743.370m	349.059m
GCP	8	455733.267m	114714.664m	349.754m

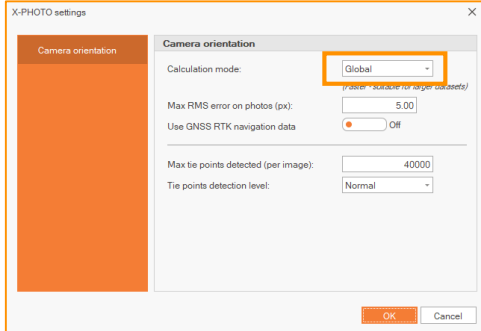
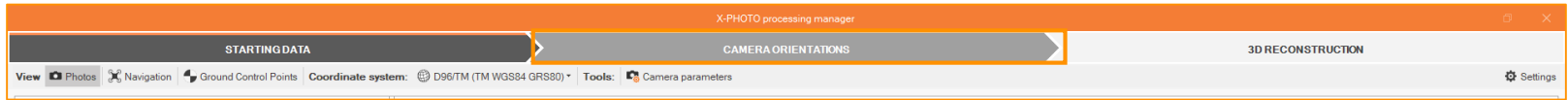
Starting Data



Aerial Photo Processing

Camera orientation

Camera orientation is the result of a general Alignment of the images used. From this menu select **Global**. It's a necessary step to find out if we have a sufficient overlap between images

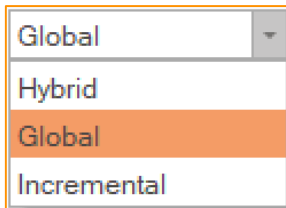
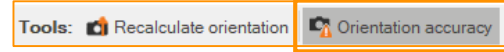


CALCULATION MODE
Different options are available with calculation algorithms based on the dataset

Hybrid Global + Incremental
Global Faster - suitable for larger database
Incremental
Slower - suitable for smaller database

MAX RMS error
Root Mean Square error, it is a global indicator of the quality. The lower is the RMS value, the better is the solution. After calculation, it's possible to select "**Orientation Accuracy**" to check the RMS values.

Tie Points are points of interest that can be recognized on images

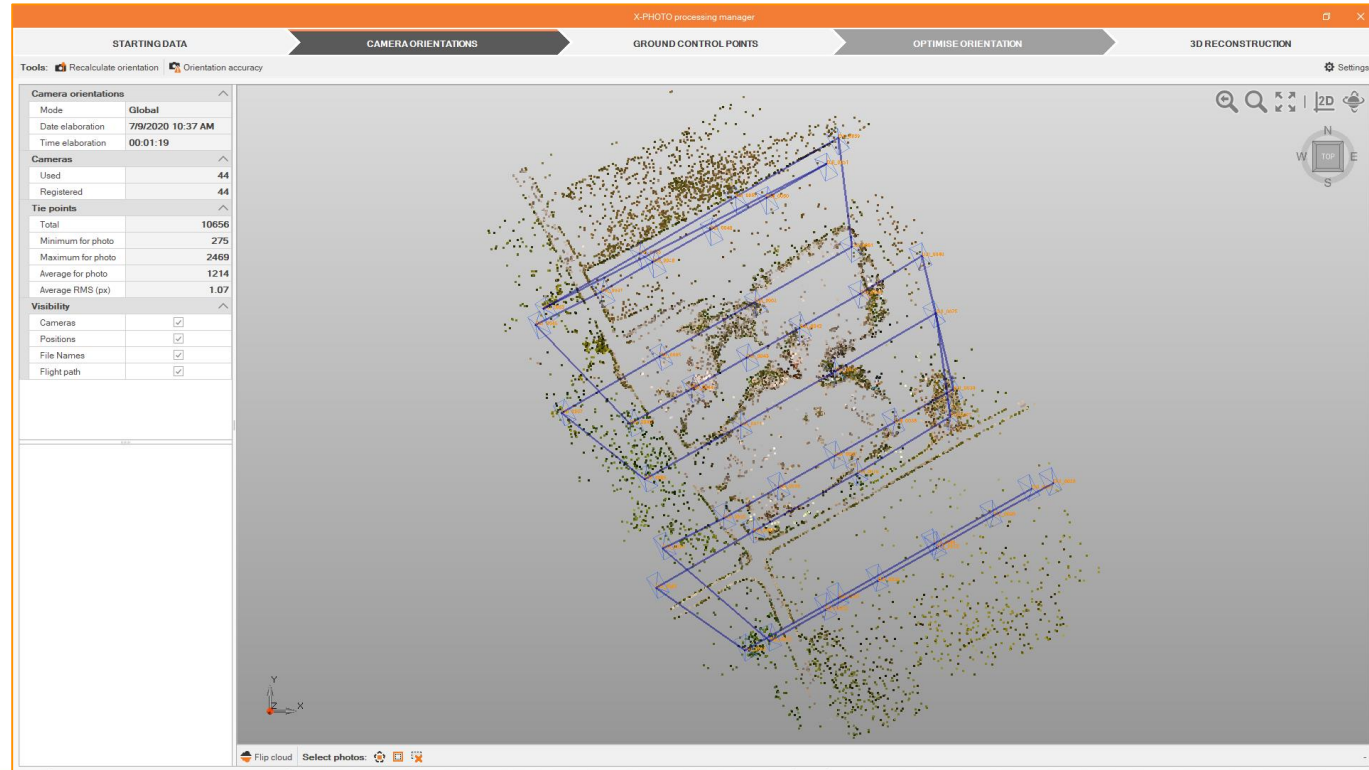


Aerial Photo Processing

Camera orientation

Camera orientation is the result of a general Alignment of the images used. From this menu select **Global**. It's a necessary step to find out if we have a sufficient overlap between images

Camera orientations	
Mode	Global
Date elaboration	7/9/2020 10:37 AM
Time elaboration	00:01:19
Cameras	
Used	44
Registered	44
Tie points	
Total	10656
Minimum for photo	275
Maximum for photo	2469
Average for photo	1214
Average RMS (px)	1.07
Visibility	
Cameras	<input checked="" type="checkbox"/>
Positions	<input checked="" type="checkbox"/>
File Names	<input checked="" type="checkbox"/>
Flight path	<input checked="" type="checkbox"/>



The screenshot shows the 'CAMERA ORIENTATIONS' step in the X-PHOTO processing manager. The main window displays a 3D point cloud of a terrain with a flight path overlaid. The left sidebar shows the 'Camera orientations' table with the following data:

Camera orientations	
Mode	Global
Date elaboration	7/9/2020 10:37 AM
Time elaboration	00:01:19
Cameras	
Used	44
Registered	44
Tie points	
Total	10656
Minimum for photo	275
Maximum for photo	2469
Average for photo	1214
Average RMS (px)	1.07
Visibility	
Cameras	<input checked="" type="checkbox"/>
Positions	<input checked="" type="checkbox"/>
File Names	<input checked="" type="checkbox"/>
Flight path	<input checked="" type="checkbox"/>

Hybrid

Global+Incremental

Global

Faster - suitable for larger data base

Incremental

Slower - suitable for smaller database

Starting
Data

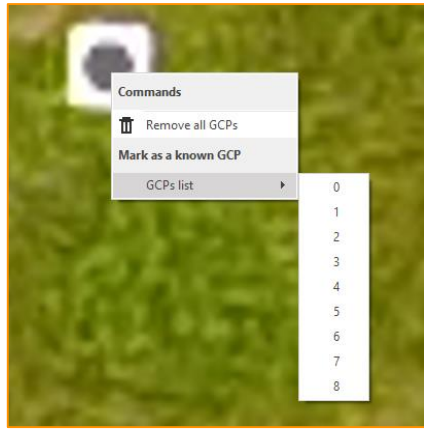
Camera
Orientation



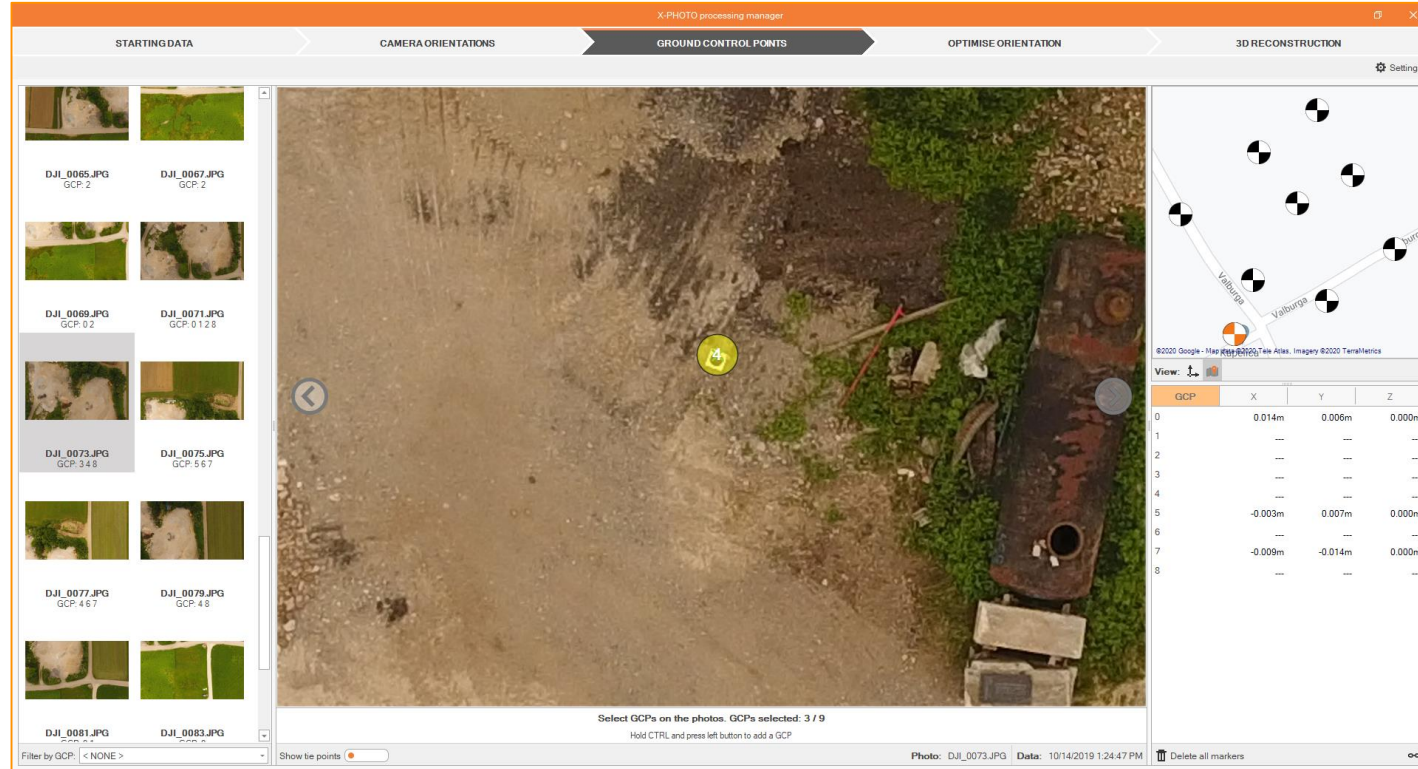
Aerial Photo Processing

GCP definition

Manual definition of at least three **GCP** and automatic target recognition of all the others. Hold CTRL and press left button to add a GCP, or press right button and select the GCP from the list to mark the GCP as a known GCP.



It is also possible to select the GCP using **filter** option or directly from **CAD/MAP**



STARTING DATA CAMERA ORIENTATIONS **GROUND CONTROL POINTS** OPTIMISE ORIENTATION 3D RECONSTRUCTION

Filter by GCP: < NONE > Show tie points:

Select GCP's on the photos. GCP's selected: 3 / 9
Hold CTRL and press left button to add a GCP

GCP	X	Y	Z
0	0.014m	0.006m	0.000m
1	---	---	---
2	---	---	---
3	---	---	---
4	---	---	---
5	-0.003m	0.007m	0.000m
6	---	---	---
7	-0.009m	-0.014m	0.000m
8	---	---	---

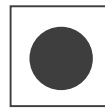
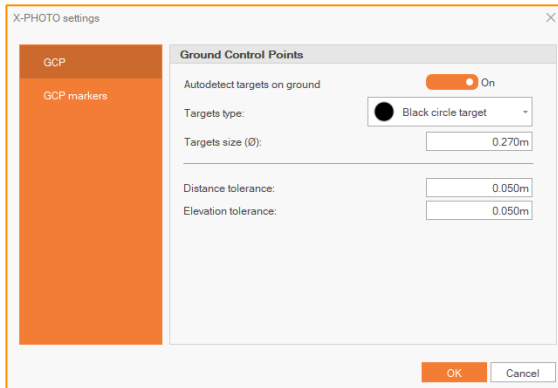
Photo: DJI_0073.JPG Data: 10/14/2019 1:24:47 PM Delete all markers



Aerial Image Processing

Targets Adjustment

After the manual definition of at least three GCP, we can use automatic target recognition of all the others using GeoMax type or distance and elevation tolerances.

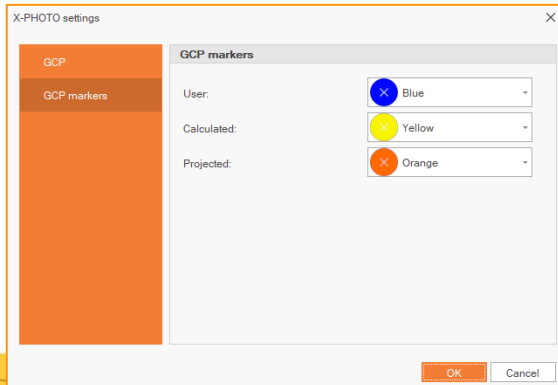


Using “**Black circle marker**” it’s possible to use **Automatic GCP detection**

Targets available from:

C:\Program Files\GeoMax\X-PAD Office Fusion\Targets

If no targets have been used, it is possible to set the tolerances for distance and elevation



GCP markers allows you to set different colors depending on whether the targets are chosen by: user, calculated or projected

Starting
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Aerial Image Processing

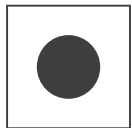
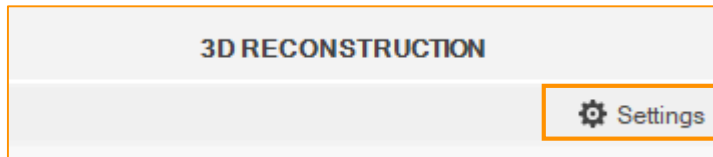
Targets Adjustment



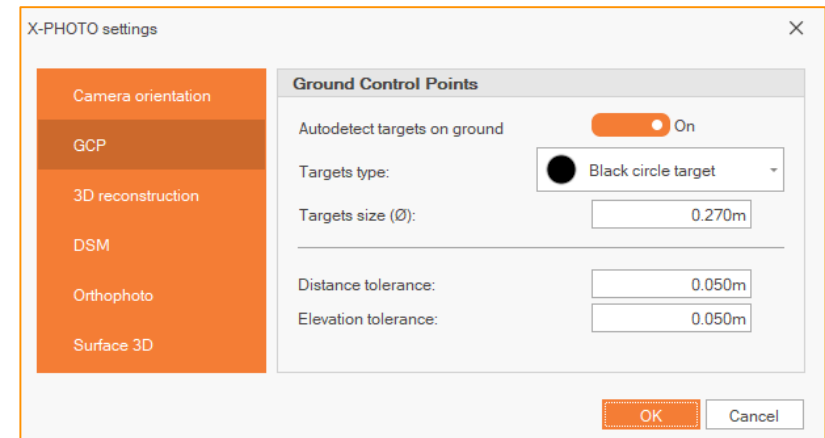
After the manual definition of at least three GCP, we can use automatic target recognition of all the others using GeoMax type or distance and elevation tolerances.

We need to select minimum three GCPs on the images in order to start Calibration

Using images with GPS position it's possible to filter GCPs by position



Using “**Black circle marker**” it's possible to use **Automatic GCP detection**



Targets available from: **C:\Program Files\GeoMax\X-PAD Office Fusion\Targets**

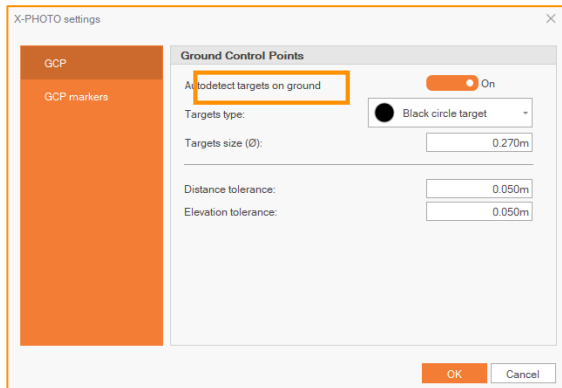


Aerial Photo Processing

Optimise Orientation

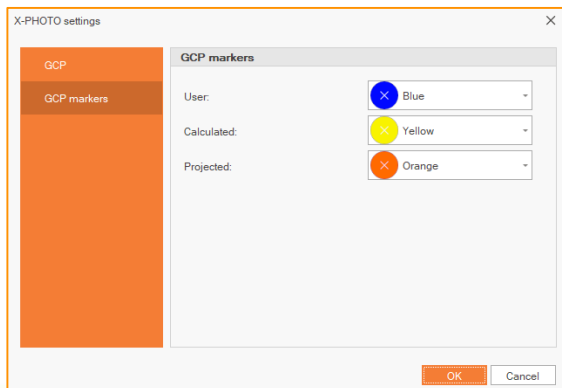


From **Optimise Calibration** menu it's possible to adjust markers position and improve the results of automatic target recognition



After the manual definition of at least three GCP, we can use automatic target recognition of all the others using GeoMax type or distance and elevation tolerances.

We need to select minimum three GCPs on the images in order to start Calibration



Using images with GPS position it's possible to filter GCPs by position

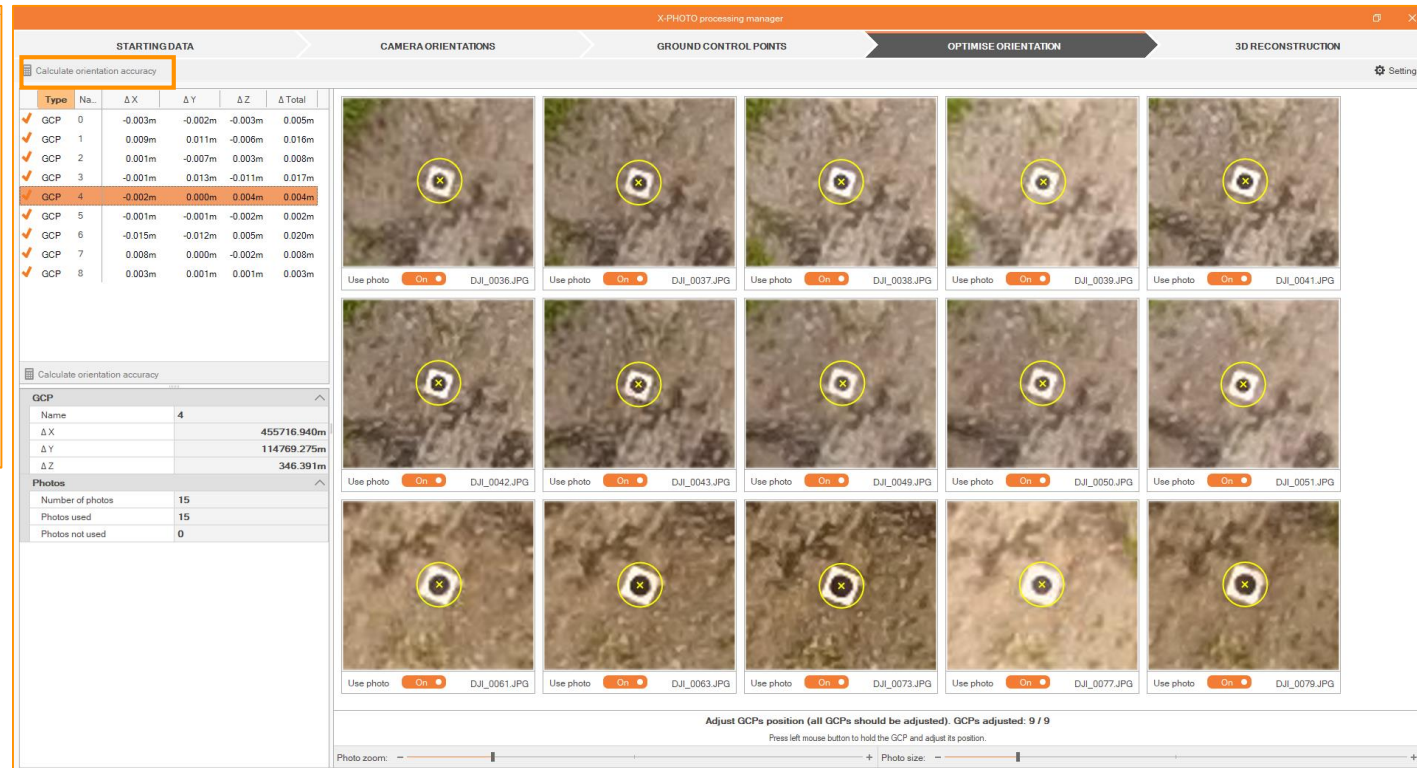


Aerial Photo Processing

Optimise Orientation

From **Optimise Calibration** menu it's possible to adjust markers position and improve the results of automatic target recognition

Type	Na...	Δ X	Δ Y	Δ Z	Δ Total
✓ GCP	0	-0.003m	-0.002m	-0.003m	0.005m
✓ GCP	1	0.009m	0.011m	-0.006m	0.016m
✓ GCP	2	0.001m	-0.007m	0.003m	0.008m
✓ GCP	3	-0.001m	0.013m	-0.011m	0.017m
✓ GCP	4	-0.002m	0.000m	0.004m	0.004m
✓ GCP	5	-0.001m	-0.001m	-0.002m	0.002m
✓ GCP	6	-0.015m	-0.012m	0.005m	0.020m
✓ GCP	7	0.008m	0.000m	-0.002m	0.008m
✓ GCP	8	0.003m	0.001m	0.001m	0.003m



STARTING DATA

Type	Na...	Δ X	Δ Y	Δ Z	Δ Total
✓ GCP	0	-0.003m	-0.002m	-0.003m	0.005m
✓ GCP	1	0.009m	0.011m	-0.006m	0.016m
✓ GCP	2	0.001m	-0.007m	0.003m	0.008m
✓ GCP	3	-0.001m	0.013m	-0.011m	0.017m
✓ GCP	4	-0.002m	0.000m	0.004m	0.004m
✓ GCP	5	-0.001m	-0.001m	-0.002m	0.002m
✓ GCP	6	-0.015m	-0.012m	0.005m	0.020m
✓ GCP	7	0.008m	0.000m	-0.002m	0.008m
✓ GCP	8	0.003m	0.001m	0.001m	0.003m

GCP 4 Summary:

- Name: 4
- Δ X: 455716.940m
- Δ Y: 114769.275m
- Δ Z: 346.391m

Photos:

- Number of photos: 15
- Photos used: 15
- Photos not used: 0

Adjust GCPs position (all GCPs should be adjusted). GCPs adjusted: 9 / 9

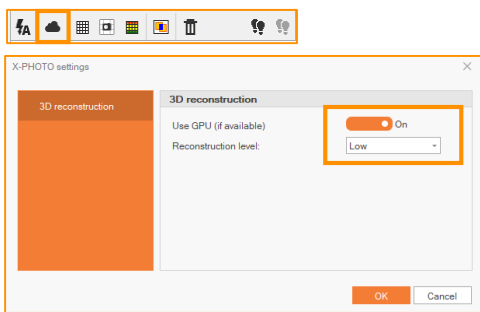
We recommend to adjust the GPCs position from at least three GPCs and using different images



Aerial Photo Processing

3D Reconstruction

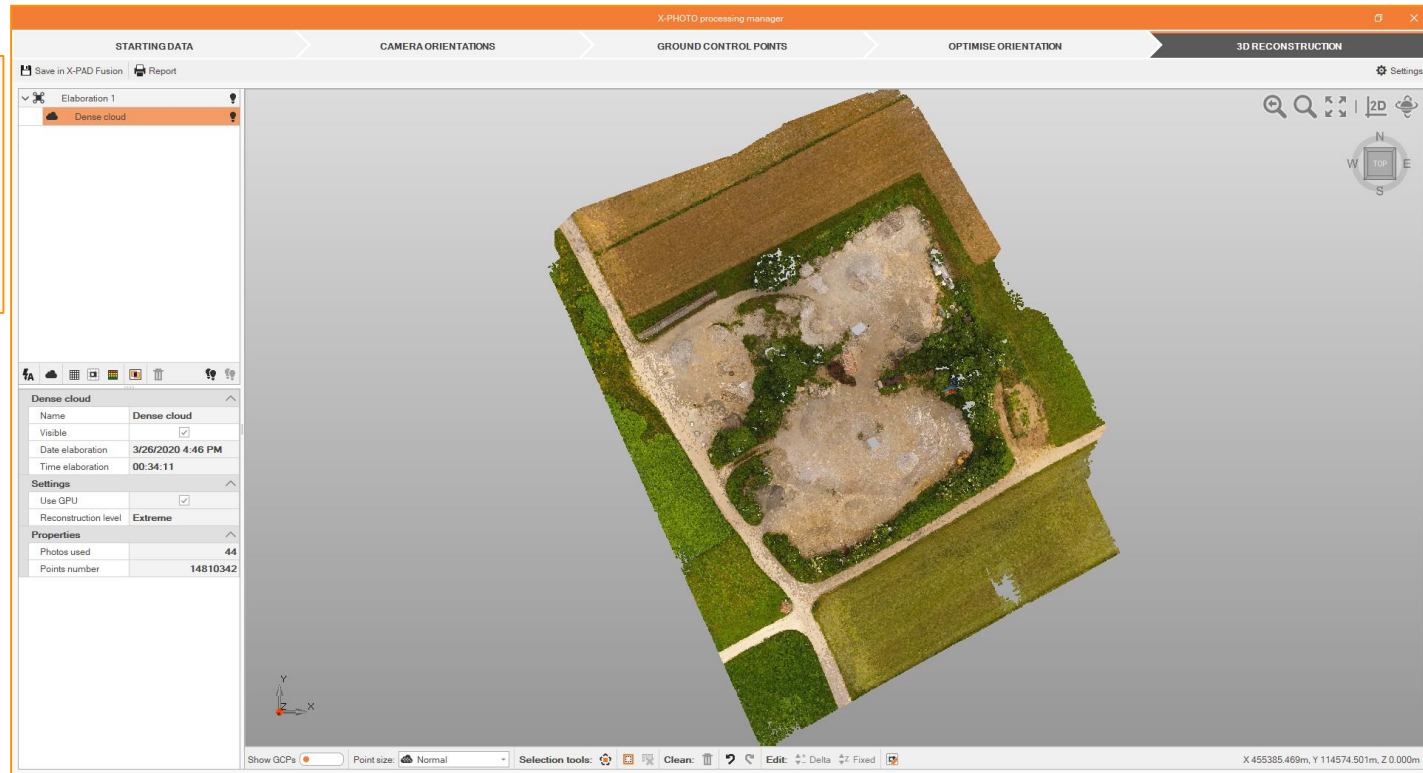
After Calibration we can run Dense Cloud process and create the corresponding Points Cloud in Low, Medium, High or Extreme resolution



GPU

This command allows to improve calculation using the dedicated GPU (Graphic Processing Unit)

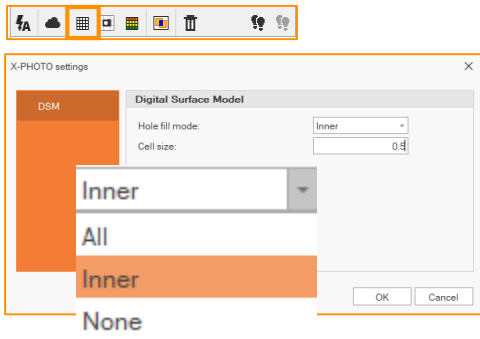
Using GPU we can increase the number of points created with the same reconstruction level



Aerial Photo Processing

DSM

From Elaboration menu it's possible to create DSM (Digital Surface Model) from Dense Cloud. DSM is a surface representing the highest elevation of a terrain

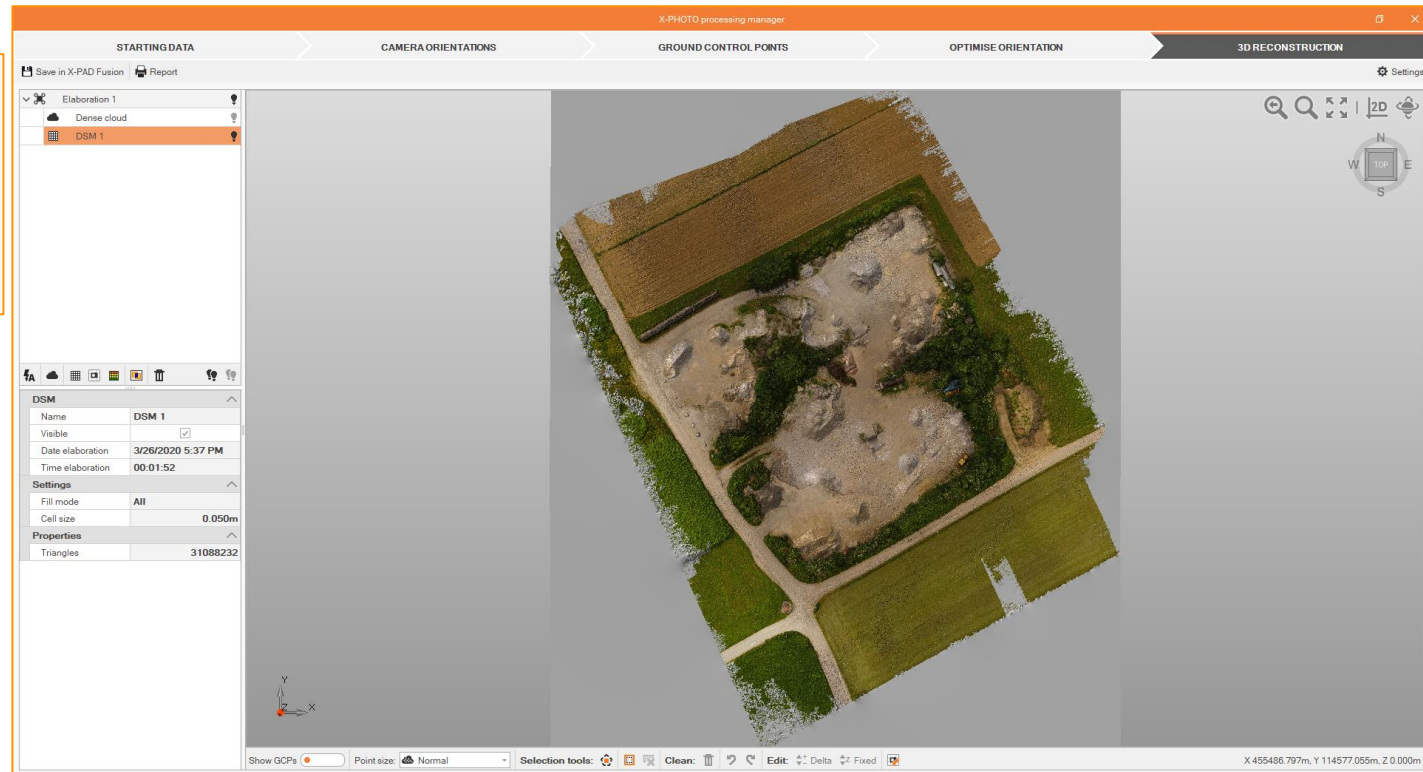


Hole fill

It's possible to select one of the available mode to fill the DSM hole

Cell Size

It's possible to reduce this value in order to increase the DSM quality



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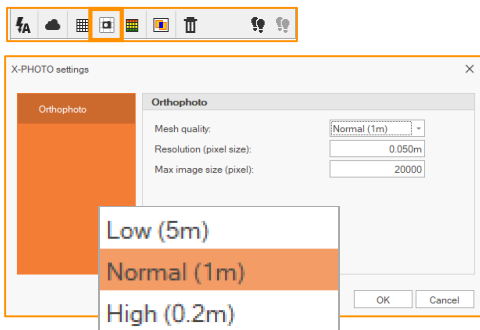
Elaborations



Aerial Photo Processing

Orthophoto

From Elaboration menu it's possible to create Orthophotos from Dense Cloud

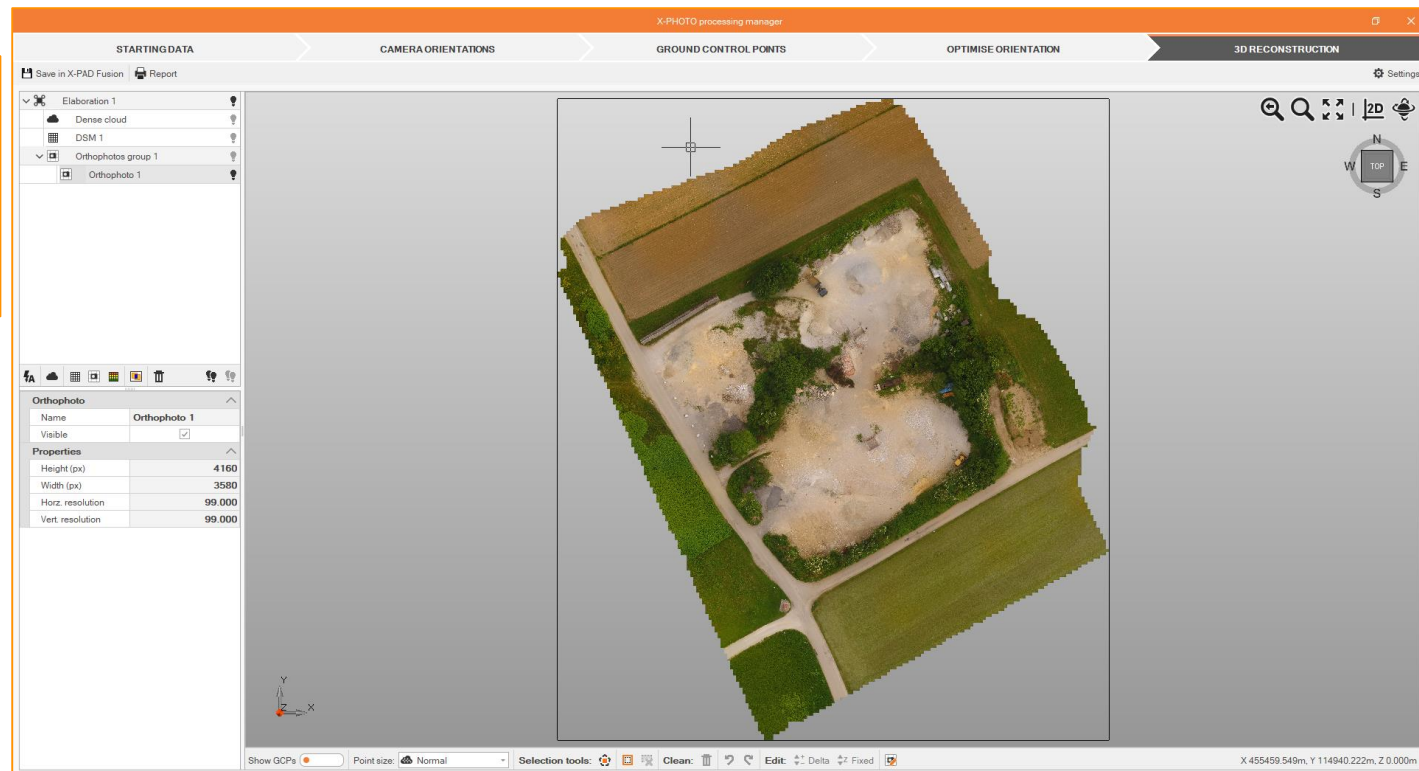


Mesh quality

It's possible to select one of the available quality

Resolution and size

It's possible to reduce the resolution value and increase the image size in order to increase the result



Starting
Data

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Orientation

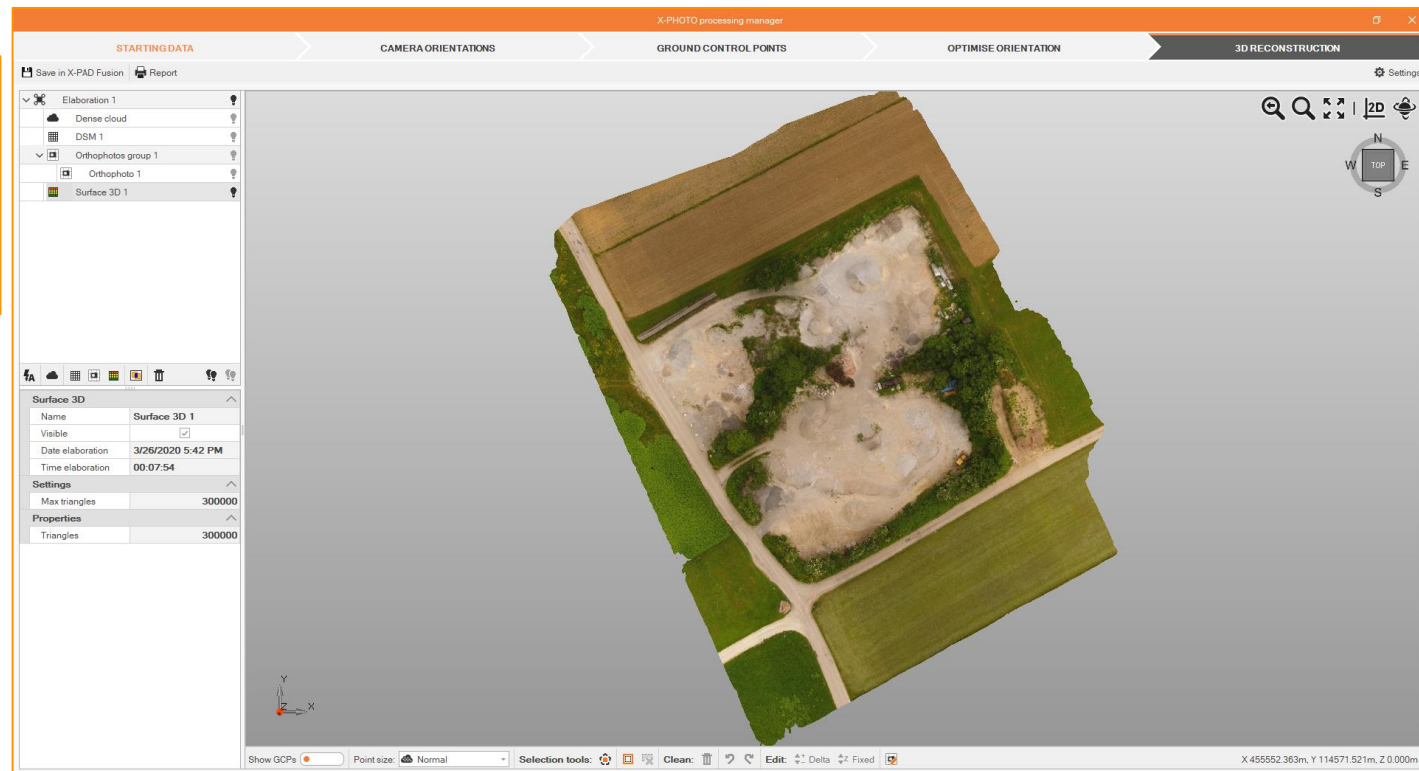
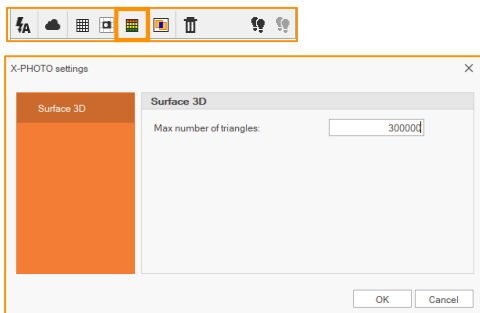
Elaborations



Aerial Photo Processing

3D Textured Surface

From Elaboration menu it's possible to create Surface 3D from Dense Cloud



Resolution and size
It's possible to increase the max number of triangles in order to increase the result

Starting Data

Camera Orientation

GCP

Optimise Orientation

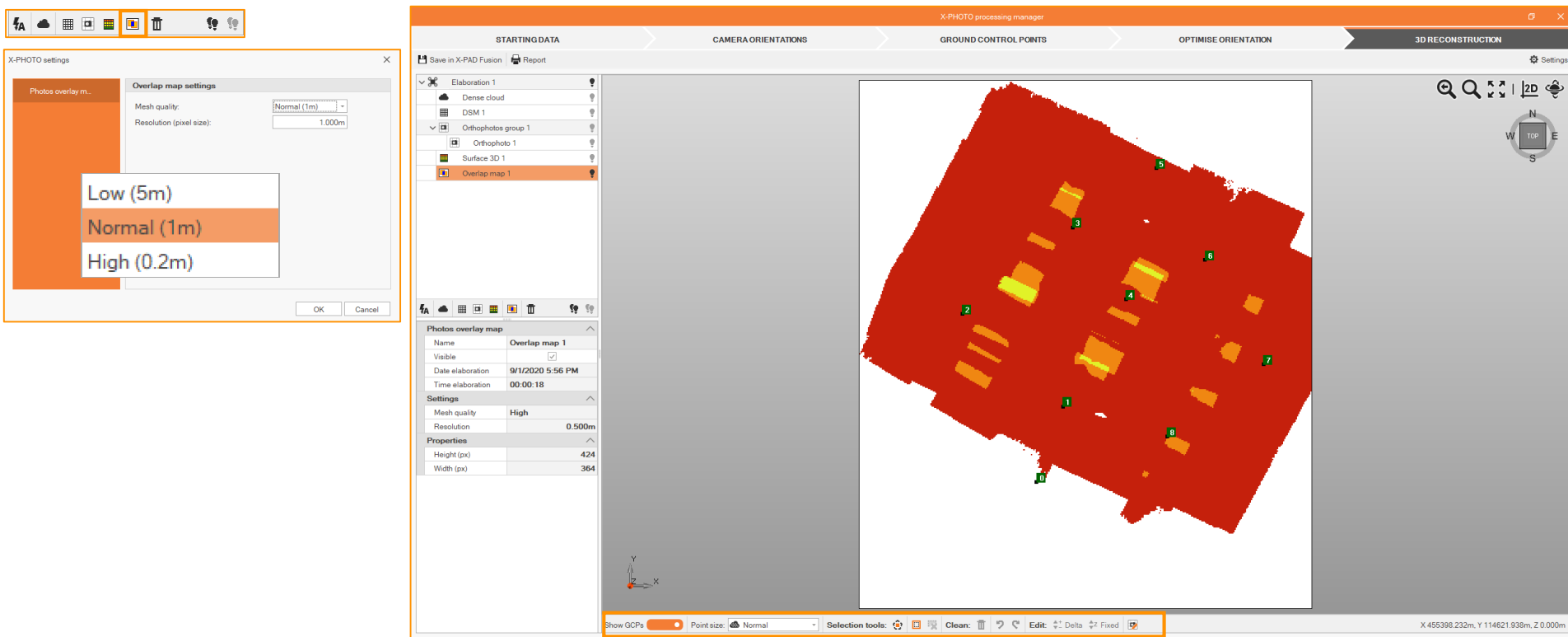
Elaborations



Aerial Photo Processing

Photos Overlay Map

From Elaboration menu it's possible to create Photos Overlay Map elaboration, which allows to check the overlaption between photos



The screenshot displays the X-PHOTO processing manager interface. The main window shows a 3D reconstruction of a building with a red overlay map. The interface includes a top navigation bar with tabs: STARTING DATA, CAMERA ORIENTATIONS, GROUND CONTROL POINTS, OPTIMISE ORIENTATION, and 3D RECONSTRUCTION. A left sidebar contains a tree view of project elements, including 'Overlap map 1'. A bottom toolbar shows various tools like 'Show GCPs', 'Point size', and 'Selection tools'. A status bar at the bottom right displays coordinates: X 455398.232m, Y 114621.938m, Z 0.000m.

An inset window titled 'X-PHOTO settings' shows the 'Overlap map settings' dialog. It includes a dropdown menu for 'Mesh quality' with options: Low (5m), Normal (1m), and High (0.2m). The 'Resolution (pixel size)' is set to 1.000m. The dialog has 'OK' and 'Cancel' buttons.

Property	Value
Name	Overlap map 1
Visible	<input checked="" type="checkbox"/>
Date elaboration	9/1/2020 5:56 PM
Time elaboration	00:00:18
Settings	
Mesh quality	High
Resolution	0.500m
Properties	
Height (px)	424
Width (px)	364

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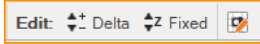
Aerial Photo Processing

X-Photo Tools

From Elaboration menu it's possible to use different tools for Visualization, Clean and Editing Point Cloud



Selection tools available to clean Point Cloud



Editing tools available to modify elevation of selected points with a delta or fixed elevation; corrects the selected zone of the orthophoto by applying one single photo



The screenshot shows the 'X-PHOTO processing manager' interface. The top navigation bar includes: STARTING DATA, CAMERA ORIENTATIONS, GROUND CONTROL POINTS, OPTIMISE ORIENTATION, and 3D RECONSTRUCTION (which is the active tab). The main view displays a 3D point cloud of a landscape with a red highlighted area. On the left, there is a tree view showing the project structure: Elaboration 1, Dense cloud, DSM 1, Orthophotos group 1, Orthophoto 1, Surface 3D 1, and Overlap map 1. Below the tree view is a 'Dense cloud' properties panel with the following details:

Name	Dense cloud
Visible	<input checked="" type="checkbox"/>
Date elaboration	3/26/2020 4:46 PM
Time elaboration	00:34:11
Settings	
Use GPU	<input checked="" type="checkbox"/>
Reconstruction level	Extreme
Properties	
Photos used	44
Points number	14810342

At the bottom of the interface, there is a toolbar with 'Show GCPs' (checked), 'Point size: Normal', and the same selection and edit toolbars seen in the previous images. The status bar at the bottom right shows coordinates: X 455369.910m, Y 115041.045m, Z 0.000m.



Aerial Photo Processing

Save Elaboration - Report



From main menu it's possible select **Save data in X-PAD Fusion** with the outputs that have to be saved or create the **X-Photo Report**

The screenshot displays the X-PAD Fusion software interface. The main window shows a 3D reconstruction of a site with a building and surrounding terrain. The interface includes a top navigation bar with tabs: STARTING DATA, CAMERA ORIENTATIONS, GROUND CONTROL POINTS, OPTIMISE ORIENTATION, and 3D RECONSTRUCTION. The 3D RECONSTRUCTION tab is active, showing a 3D model of the site. The left sidebar contains a list of data elements for 'Elaboration 1', including Dense cloud, DSM 1, Orthophotos group 1, Orthophoto 1, Surface 3D 1, and Overlap map 1. The bottom status bar shows coordinates: X 455365.297m, Y 114940.000m, Z 0.000m.

Save data in X-PAD Fusion

Select the 3D results that have to be saved:

3D Result	Add	Solid orthophoto
Elaboration 1	<input checked="" type="checkbox"/>	
Dense cloud	<input checked="" type="checkbox"/>	
DSM 1	<input checked="" type="checkbox"/>	
Orthophotos group 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Orthophoto 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Surface 3D 1	<input checked="" type="checkbox"/>	
Overlap map 1	<input checked="" type="checkbox"/>	

Save in X-PAD Fusion Close

Save Data

Select X-PHOTO session

X-PHOTO session: DRONE

Elaboration: Elaboration 1

Elements:

DSM	<input checked="" type="checkbox"/>
DSM 1	<input checked="" type="checkbox"/>
Orthophoto	<input checked="" type="checkbox"/>
Orthophotos group 1	<input checked="" type="checkbox"/>
Surface 3D	<input checked="" type="checkbox"/>
Surface 3D 1	<input checked="" type="checkbox"/>
Photos overlay map	<input checked="" type="checkbox"/>

OK Cancel

Report

X-PHOTO processing manager

STARTING DATA CAMERA ORIENTATIONS GROUND CONTROL POINTS OPTIMISE ORIENTATION 3D RECONSTRUCTION

Save in X-PAD Fusion Report

Elaboration 1

- Dense cloud
- DSM 1
- Orthophotos group 1
 - Orthophoto 1
 - Surface 3D 1
 - Overlap map 1

Elaboration

Name	Elaboration 1
Visible	<input checked="" type="checkbox"/>
Date elaboration	3/26/2020 4:46 PM
Time elaboration	00:34:11

Cameras

Cameras	<input type="checkbox"/>
Positions	<input type="checkbox"/>
File Names	<input type="checkbox"/>
Pictures	<input type="checkbox"/>

Fight

Fight path	<input type="checkbox"/>
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Show GCPs Point size: Normal Selection tools: Clean: Edit: Delta Fixed

X 455365.297m, Y 114940.000m, Z 0.000m

Starting
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GCP

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Aerial Photo Processing Report



From X-Photo Report it's possible to create a summary reports from processing to selected outputs

The screenshot displays the X-Photo Report software interface. On the left, a 'Select X-PHOTO session' dialog box is open, showing the following configuration:

- X-PHOTO session: DRONE
- Elaboration: Elaboration 1
- Elements:
 - DSM:
 - DSM 1:
 - Orthophoto:
 - Orthophotos group 1:
 - Surface 3D:
 - Surface 3D 1:
 - Photos overlay map:

The main 'Report Manager' window shows a grid of report thumbnails. The top row contains four thumbnails: a 3D perspective view of a building, a table of metadata, a DSM (Digital Surface Model) heatmap, and an orthophoto. The bottom row contains three thumbnails, all showing the same 3D perspective view of the building. The interface includes a menu bar with options like 'Main', 'Report', 'Print', 'Export', and 'Page setup', and a toolbar with navigation and zoom controls.

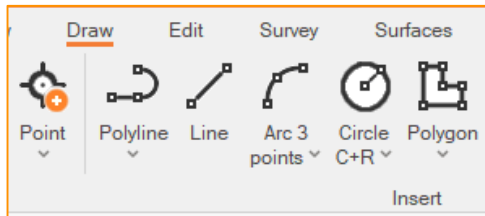


Stereo Drawing

X-Photo Drawing tools



Based on analytical photogrammetry process we can use the Stereo Drawing function for the manual computation of coordinates in 3D space



After selecting **Stereo Drawing** function, we can use one of the drawing tools from Draw menu.



We can select points and vertexes from **graphic view** or directly from the photos from **Stereo Drawing** panel.

Once created the point or object we can re-open Stereo Drawing panel and adjust vertexes position



Solid Orthophoto Drawing



X-Photo Drawing tools

We can use drawing functionalities on the **Solid Orthophotos** created from X-Photo menu. The point's selection is done in 2D while the Point's **elevation** is automatically adjusted by the information from X-Photo data

The screenshot displays the X-PAD Office Fusion software interface. The main window shows a 2D aerial view of a landscape with a road and fields. Several points are marked on the ground with numbers 32, 33, 34, and 35. The software interface includes a top menu bar with options like File, Home, View, Draw, Edit, Survey, Surfaces, Design 3D, Imaging, X-sections, Cadastral, Cloud, X-live, Output, and Search. Below the menu is a toolbar with various drawing tools such as Polyline, Line, Arc 3 points, Circle, Polygon, Face horizontal, and Text. A Project Manager panel on the left lists various project elements including Surveys, Surfaces, Drawings, Sections groups, and Orthophotos. The Orthophotos section is highlighted, showing 'Orthophoto 1 - DRONE'. A Properties panel on the right shows the 'Snap on elevations' settings, with 'Surface' set to 'No' and 'Orthophoto solid (3)' set to 'Yes'. A smaller inset window shows a 3D point cloud view of the same area, with a Properties panel on the right displaying coordinates and other data.

Layer	Default
Color mode	By Layer
Color	255, 0, 0
Linetype mode	By Layer
Linetype	CONTINUOUS

Property	Value
Name	Cloud 1 - DRONE
Visible	<input checked="" type="checkbox"/>
Locked	<input type="checkbox"/>
Display name order	
Color	0, 128, 0
Other	
Position	
X	455701.307m
Y	114703.836m
Z	303.476m
Latitude	0.019100.0000°
Longitude	W 0.019100.0000°
Height	0.000m
Size	Unregistered
Points count	322 237
Grid mode	
File	C:\Users\PabloV\O...
Name	

