



**Ground**



**GE**  **MAX**

**TUTORIAL**  
**TERRESTRIAL IMAGE**  
**PROCESSING**

# X-PHOTO GROUND



## DESCRIPTION

- Create Point Cloud from Images
- Create 3D Surface from Point Cloud
- Stereo Drawing Tool

## GOAL

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

## DATA

- X-PHOTO TERRESTRIAL.gfdoff
- Terrestrial Images Folder





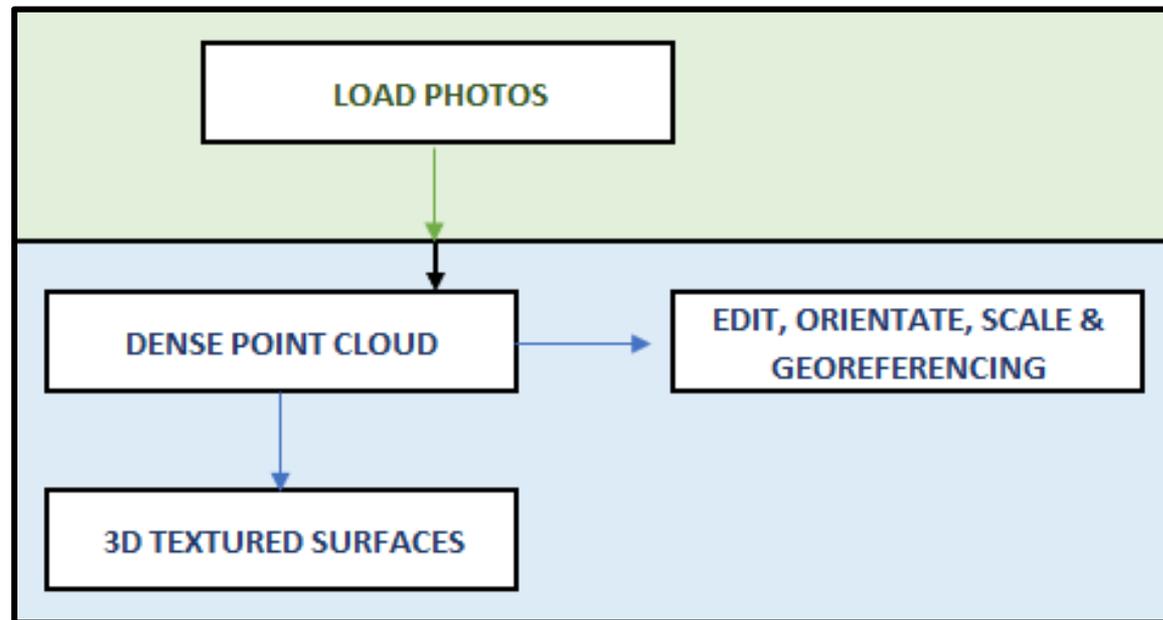
# Ground



# X-PHOTO GROUND



**Ground:** processing of max 75\* “ground “images within a max distance of 50 meters, generation of georeferenced point clouds and 3D textured surfaces



# X-PHOTO Ground

## REFERNCE POINT

3D Points with known coordinates. During the aerial and terrestrial 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

(\*) For Terrestrial Photogrammetry project

**Ground Basic** license limited to 3 Reference Point from 3D Reconstruction menu

**Aerial Pro** license unlimited Reference Point from Reference menu



# X-PHOTO Ground

## 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

## 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.

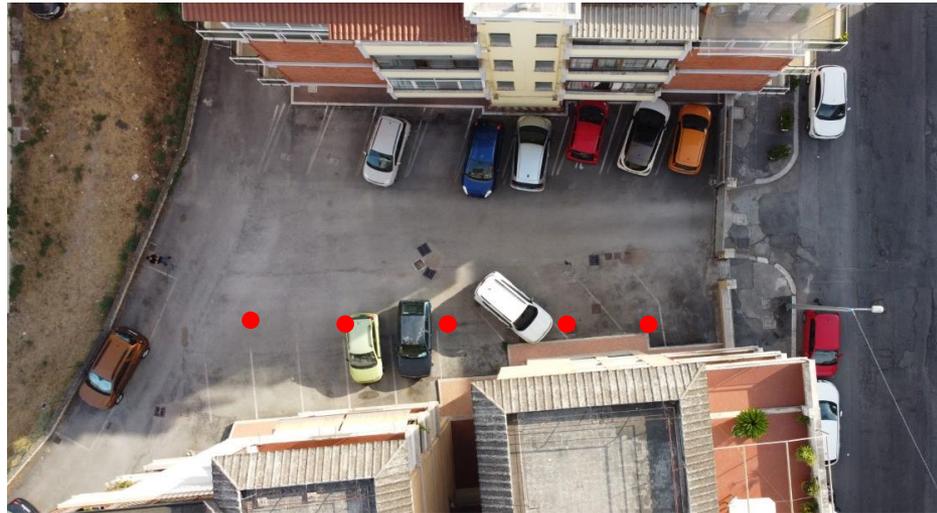


# Terrestrial Photo Processing

## Images Project - Horizontal Overlapping



Use **Terrestrial Images** folder to load photos from which it is possible to visualize camera parameters



Starting  
Data



# Terrestrial Photo Processing

## Images Project - Vertical Overlapping



Starting  
Data



# Image Processing Project

Name	Type
X_PHOTO TERRESTRIAL	XPad.Office.Fusion Document
X_PHOTO TERRESTRIAL.gfd_bak	GFD_BAK File

Survey Surfaces Design 3D Imaging X-sections

Points point Photos manager Ref.points manager Measurements

Points [Lucani\_Survey]

Type	Name	E	N	Z
ST_0001	ST_0001	325986.160m	4592201.244m	23.302m
TPS_1	TPS_1	325980.722m	4592185.424m	17.975m
TPS_2	TPS_2	325977.748m	4592187.091m	19.528m
TPS_3	TPS_3	325974.306m	4592189.026m	18.540m
TPS_4	TPS_4	325974.082m	4592190.865m	19.890m
TPS_5	TPS_5	325971.267m	4592192.166m	19.267m
TPS_6	TPS_6	325968.516m	4592192.285m	19.398m
TPS_7	TPS_7	325966.273m	4592193.538m	18.632m

Point TPS\_3

Point data

Photo and messages

Photo/Sketch

Vocal messages

No message available.

OK Cancel

From Image\_Processing folder open Fusion project: **X-PHOTO TERRESTRIAL.gfdoff**

The topographic survey was performed using **X-PAD Ultimate Survey** with **GeoMax Zoom 90** Robotic TPS orientated on 3 reference points acquired with **GeoMax Zenith35Pro** GNSS

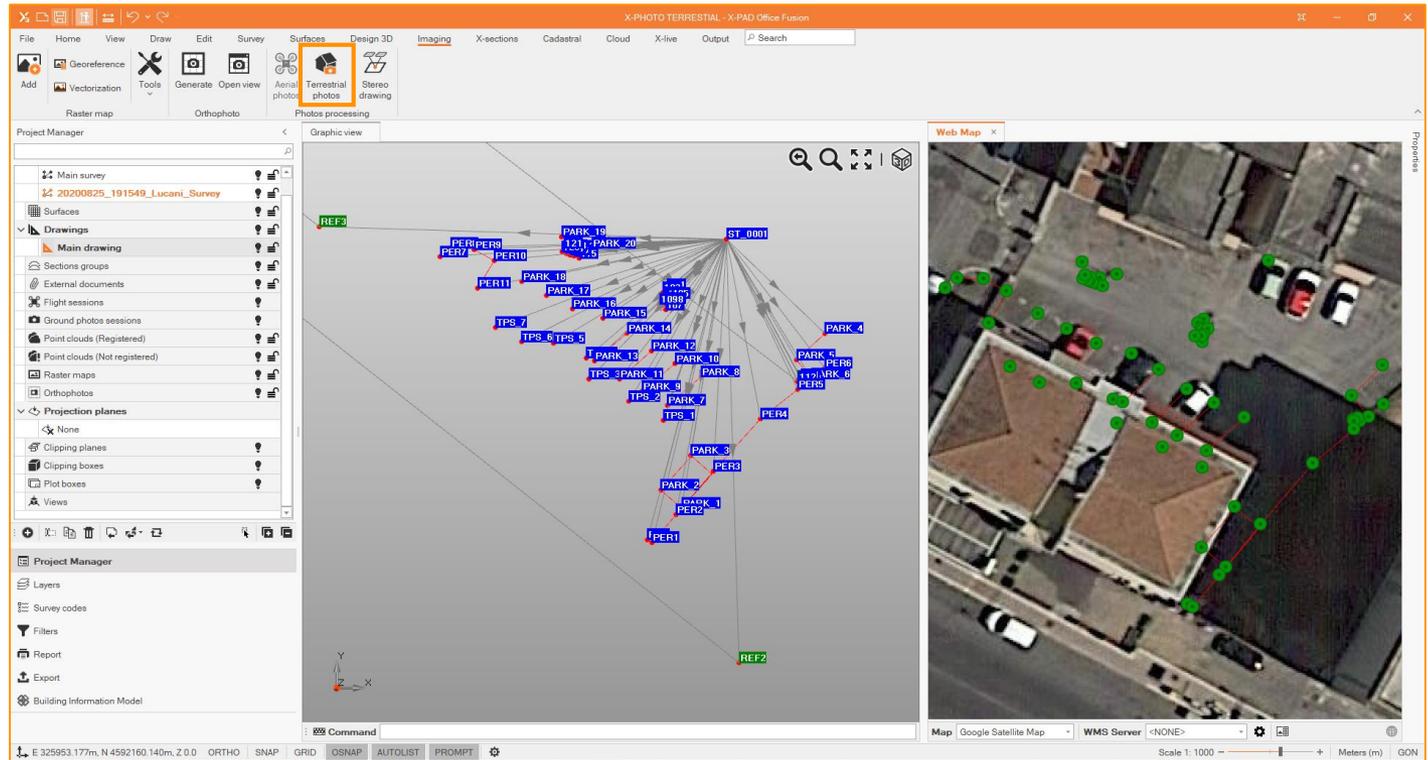
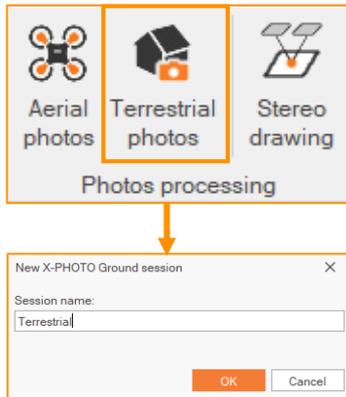
From Survey menu it is possible to select **Points** option to visualize the topographic points table and check the GCP (from **TPS\_1** to **TPS\_7**) position from the corresponding images



# Photo Processing

## Imaging Menu

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



Starting  
Data

Camera  
Orientation

GCP

Optimise  
Orientation

Elaborations



# Terrestrial Photo Processing

## Images



Use **Terrestrial Images** folder to load photos from which it is possible to visualize camera parameters



X-PHOTO processing manager

STARTING DATA      CAMERA ORIENTATIONS      3D RECONSTRUCTION

View: Photos      Tools: Camera parameters

IMG_7188.JPG	IMG_7194.JPG	IMG_7195.JPG
3/28/2020 3:53:43 PM 7.3 Mbytes	3/28/2020 3:54:35 PM 10.3 Mbytes	3/28/2020 3:54:36 PM 8.3 Mbytes
IMG_7196.JPG	IMG_7197.JPG	IMG_7198.JPG
3/28/2020 3:54:37 PM 7.4 Mbytes	3/28/2020 3:54:38 PM 5.7 Mbytes	3/28/2020 3:54:39 PM 4.6 Mbytes

Photo

Used	<input checked="" type="checkbox"/>
File name	IMG_7188.JPG
Date	3/28/2020 3:53 PM
Size	7.3 Mbytes
Width (px)	5472
Height (px)	3648
Res. horizontal	72
Res. vertical	72

Lens parameters

Producer	Canon
Model	Canon EOS 6D
Focal length (mm)	45.0

Exposure settings

Exposure time	1/100 s
Aperture	f 5.0
ISO	500

Total: 75    Used: 75    Registered: 0

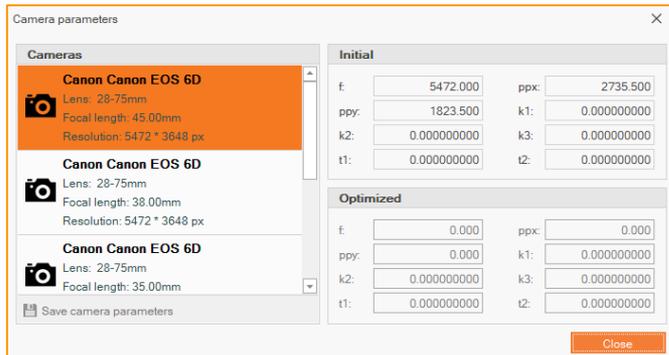
Other images  
formats are:  
JPG, BMP, PNG

Starting  
Data



# Terrestrial 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.

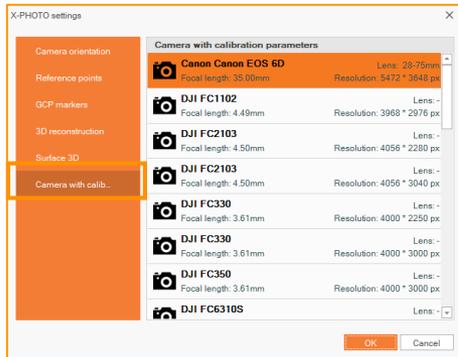


**k1, k2, k3**: radial distorsion  
**t1, t2**: tangential distorsion  
**ppx, ppy**: principal point x and y (pixels refers to image angles)  
**f**: focal length



# Terrestrial 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



# Terrestrial Photo Processing Settings



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

The screenshot displays the 'X-PHOTO processing manager' window with three main tabs: 'STARTING DATA', 'CAMERA ORIENTATIONS', and '3D RECONSTRUCTION'. A 'Settings' button is located in the top right corner. Below the main window, six smaller windows are shown, each representing a different settings category:

- Camera orientation:** Includes 'Camera orientation' (Incremental), 'Reference points' (Slower - suitable for smaller datasets), 'Photos matching strategy' (Match similar photos), and 'Advanced options' (Max tie points detected: 40000, Tie points detection level: Normal).
- Reference points:** Includes 'Autodetect targets on ground' (No), 'Targets type' (Black circle target), 'Targets size (D)' (0.270m), 'Distance tolerance' (0.050m), and 'Elevation tolerance' (0.050m).
- GCP markers:** Includes 'User' (Blue), 'Calculated' (Yellow), and 'Projected' (Orange).
- 3D reconstruction:** Includes 'Use GPU (if available)' (Yes), 'Reconstruction level' (Medium), and 'Minimum photos per calculated point' (5).
- Surface 3D:** Includes 'Max number of triangles' (100000).
- Camera with calibration parameters:** Lists various camera models and their specifications, including Canon EOS 6D, DJI FC1102, DJI FC2103, DJI FC3103, DJI FC330, DJI FC350, and DJI FC6310S.

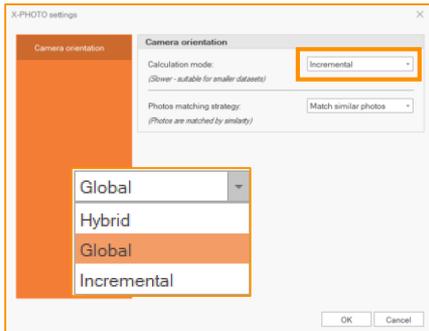
Starting Data



# 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



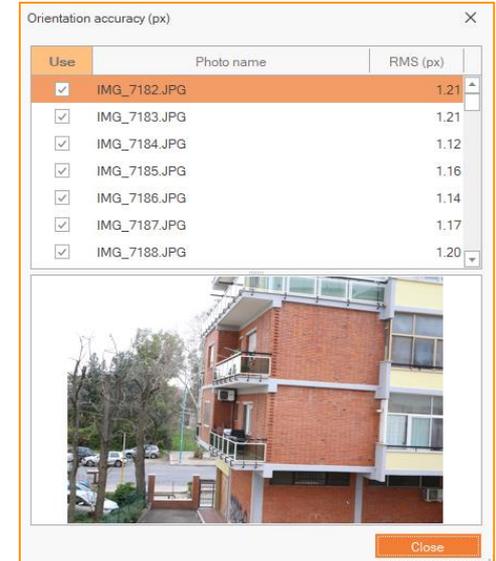
**Hybrid Global + Incremental**  
**Global** Faster - suitable for larger database  
**Incremental**  
 Slower - suitable for smaller database

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

**PHOTO MATCHING STRATEGY**  
 It's possible to match photos by similarity or all photos together

**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

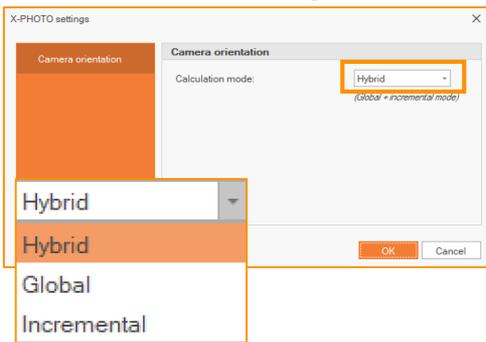


# Terrestrial Photo Processing



## Camera orientation

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



### Hybrid

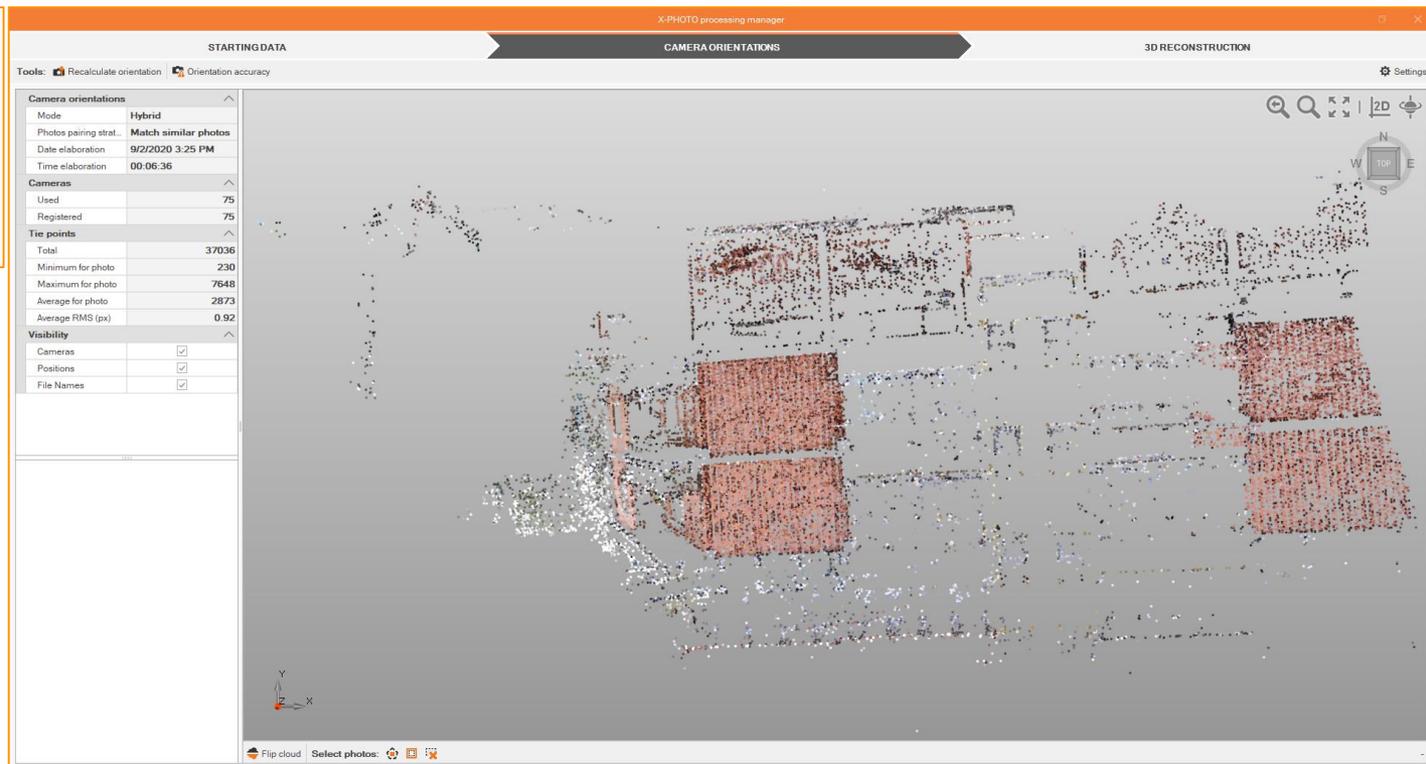
Global+Incremental

### Global

Faster - suitable for larger database

### Incremental

Slower - suitable for smaller database



Starting  
Data

Camera  
Orientation

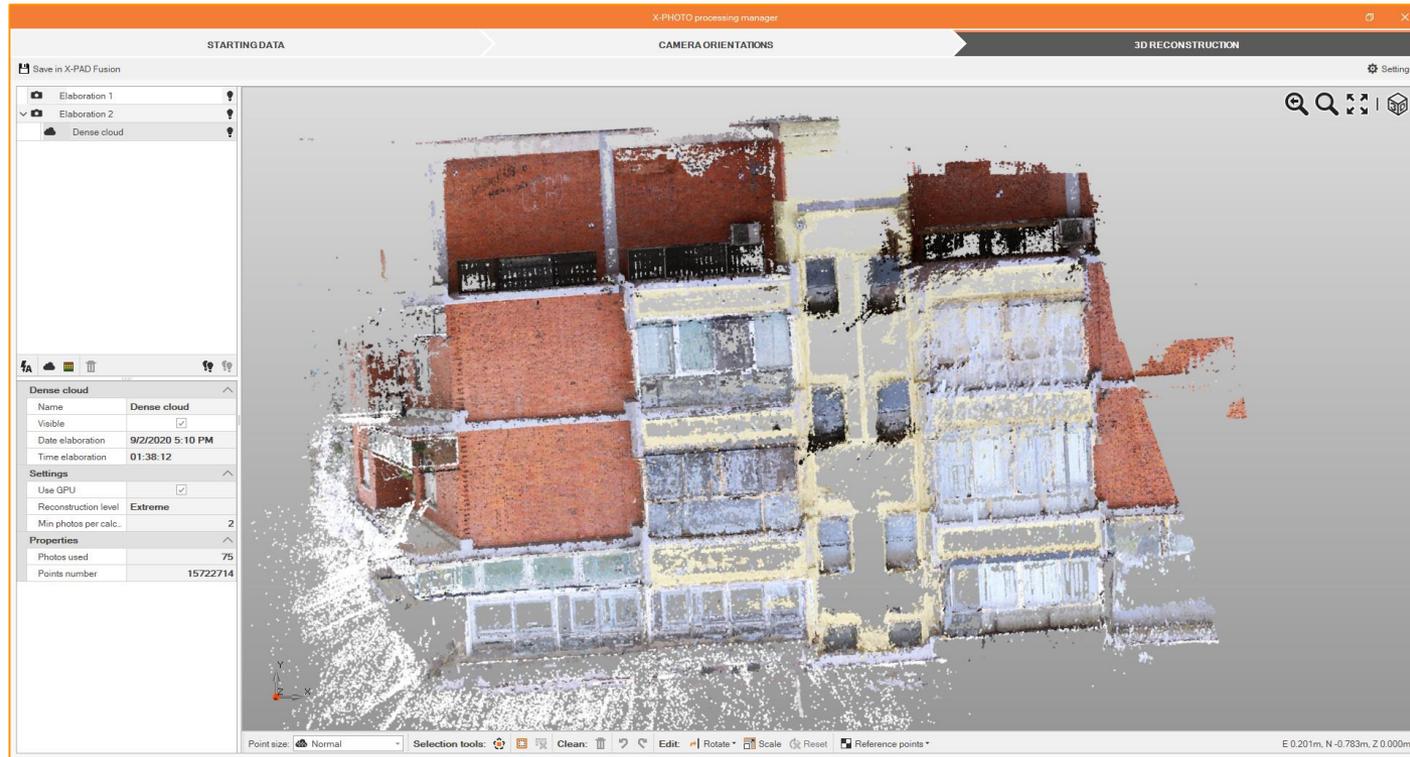
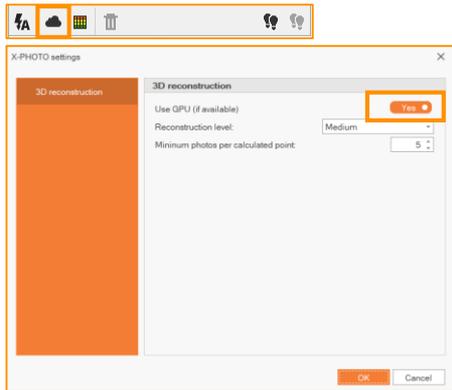


# Terrestrial Photo Processing



## 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

Starting  
Data

Camera  
Orientation

Elaborations



# Terrestrial Photo Processing



## 3D Reconstruction

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

Show reference points  Point size: Normal

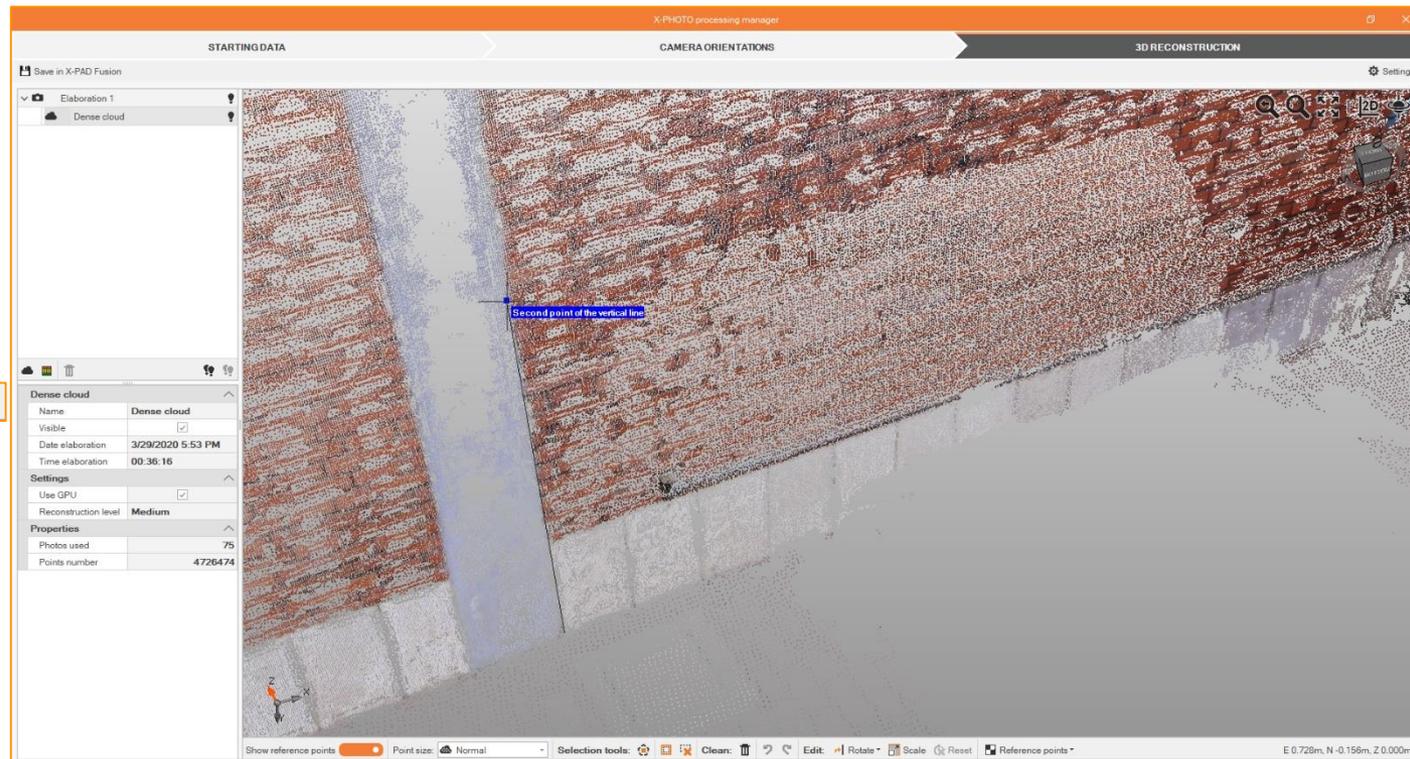
Reference Points and Point Cloud visualization

Selection tools: Clean:

Selection tools available to clean Point Cloud

Edit: Rotate Scale Reset Reference points

Editing tools available to **Rotate**, Scale Point Cloud or Add Reference Point to Georeference data



Starting Data

Camera Orientation

Elaborations



# Terrestrial Photo Processing



## 3D Reconstruction

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

Show reference points  Point size: Normal

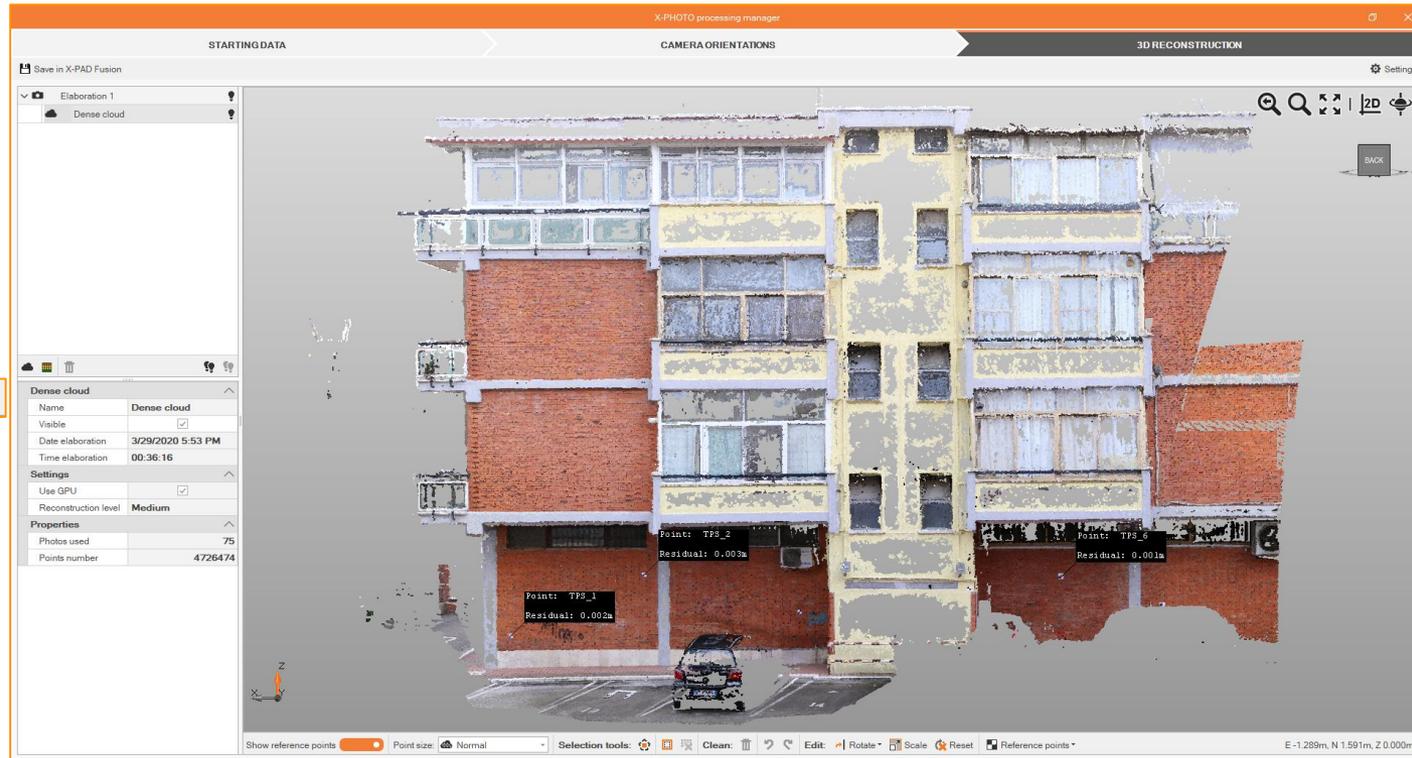
Reference Points and Point Cloud visualization

Selection tools: Clean:

Selection tools available to clean Point Cloud

Edit: Rotate Scale Reset Reference points

Editing tools available to Rotate, Scale Point Cloud or Add Reference Point to Georeference data



Starting Data

Camera Orientation

Elaborations



# Terrestrial Photo Processing



## 3D Reconstruction

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

Show reference points  Point size: Normal

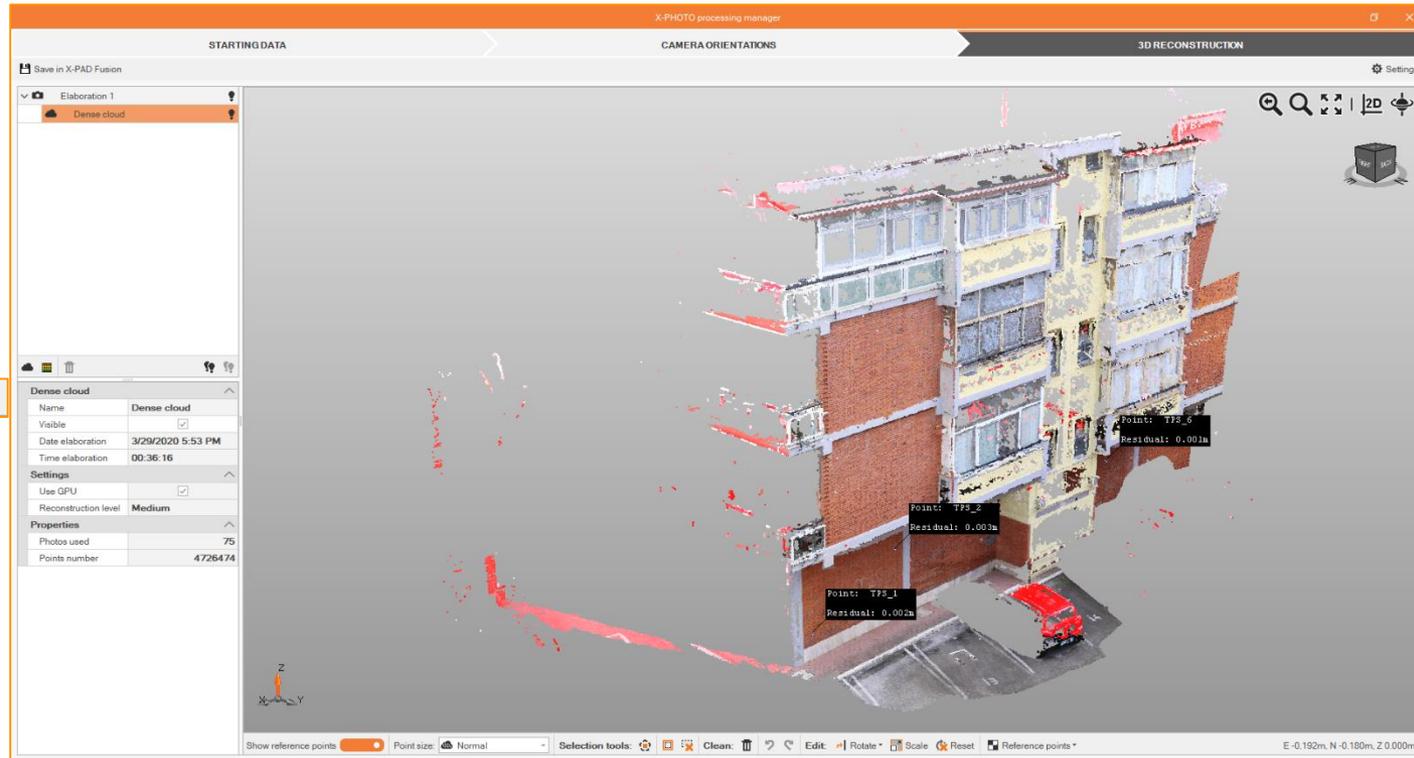
Reference Points and Point Cloud visualization

Selection tools: Clean:

Selection tools available to clean Point Cloud

Edit: Rotate Scale Reset Reference points

Editing tools available to Rotate, Scale Point Cloud or Add Reference Point to Georeference data



Starting Data

Camera Orientation

Elaborations

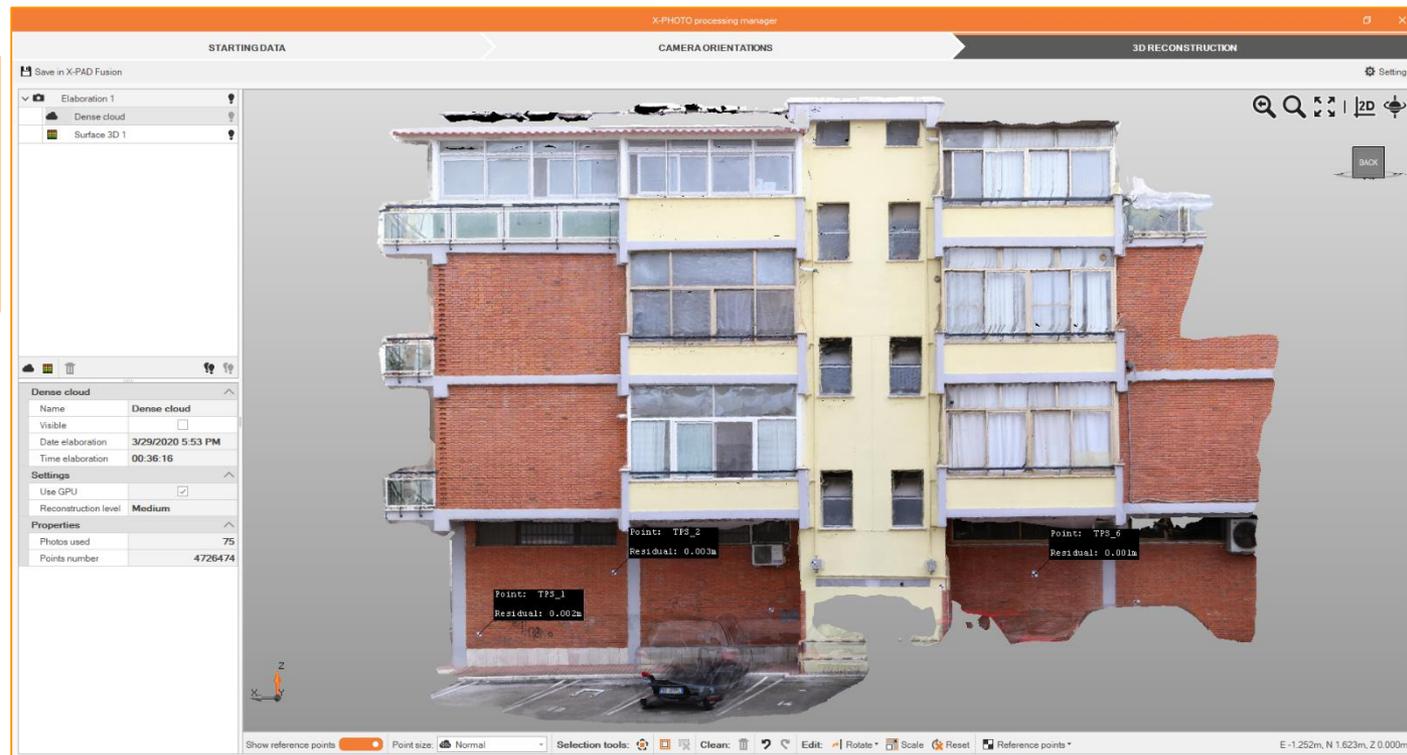
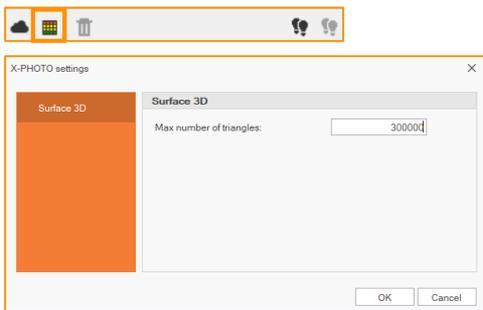


# Terrestrial Photo Processing

## 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

Elaborations

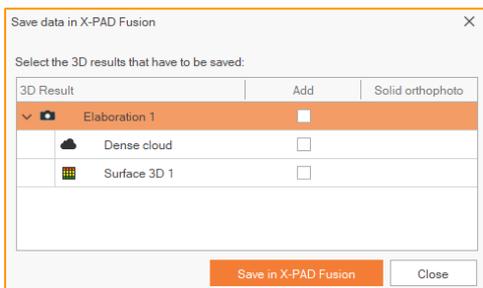


# Terrestrial Photo Processing

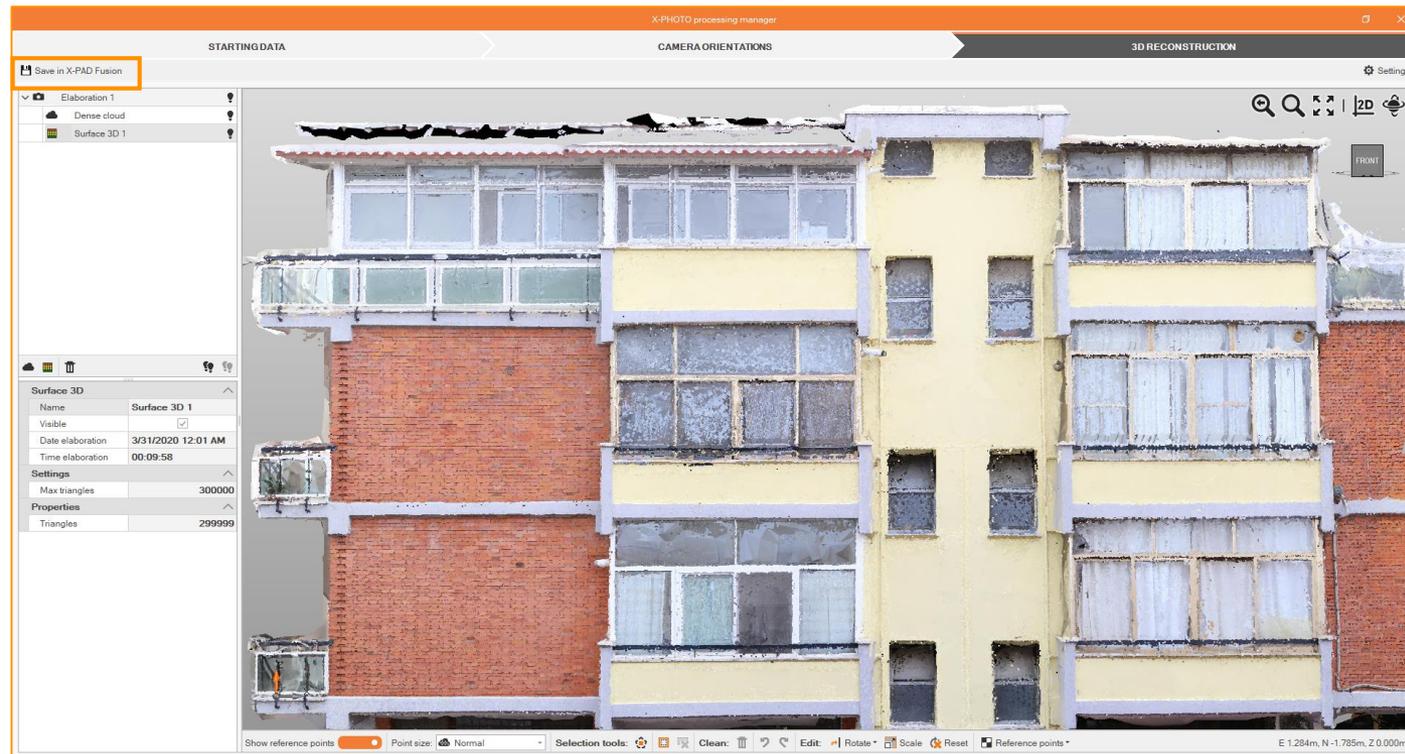


## Save Elaboration

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



Save Data



Starting  
Data

Camera  
Orientation

Elaborations

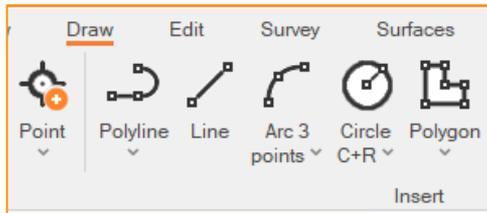


# Stereo Drawing

## 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

