Aerial + Ground 📷

ACADEMY

GEOMAX

TUTORIAL
TERRESTRIAL IMAGE
PROCESSING

X-PHOTO AERIAL + GROUND

DESCRIPTION

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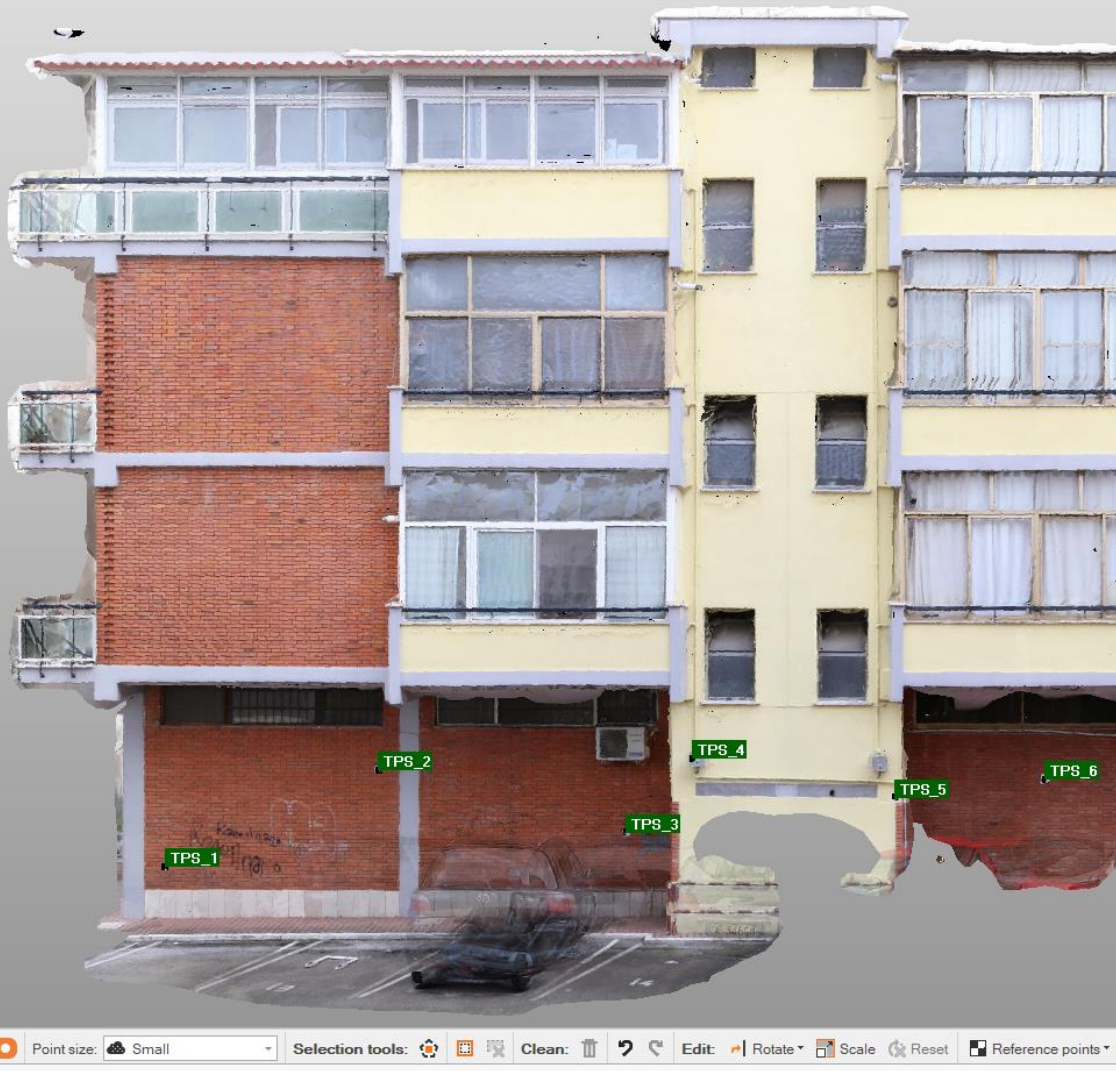- Create 3D Surface from Point Cloud
- Stereo Drawing Tool

GOAL

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

DATA
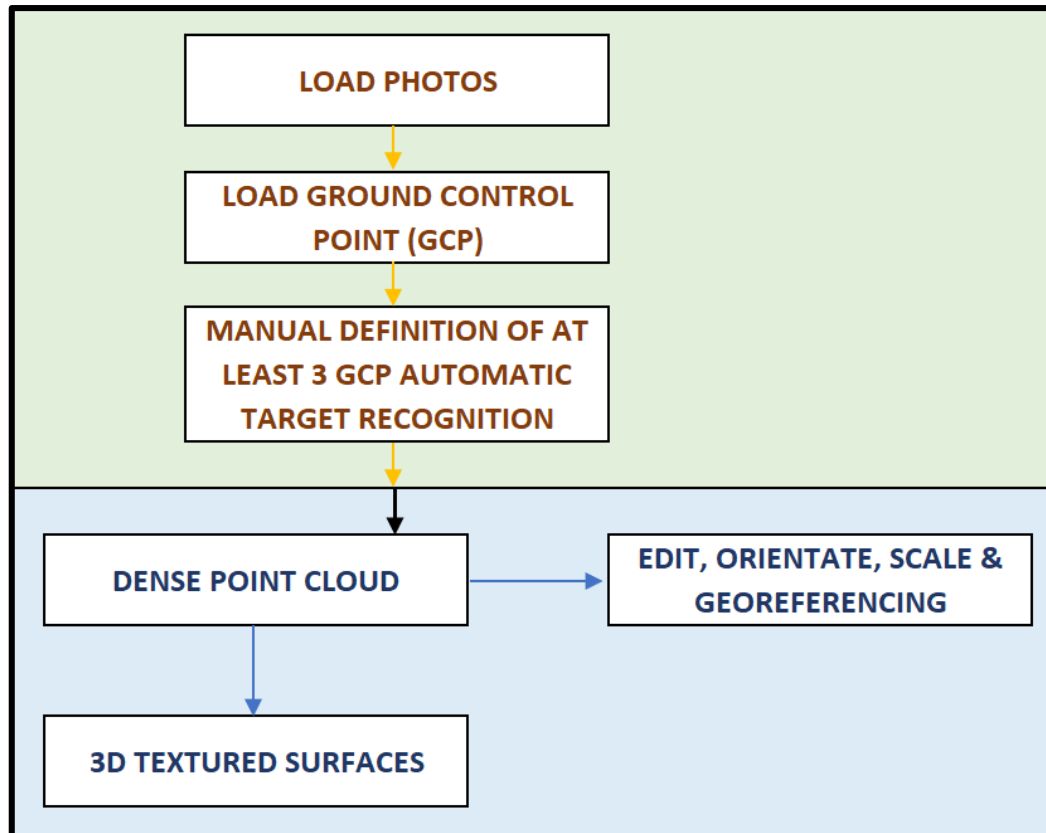
- X-PHOTO TERRESTRIAL.gfdoff
- Terrestrial Images Folder

Aerial

+

Ground

X-PHOTO GROUND

Aerial + Ground: this package allows to use additional tools, generation of georeferenced point clouds and 3D textured surfaces

Flowchart:

LOAD PHOTOS → LOAD GROUND CONTROL POINT (GCP) → MANUAL DEFINITION OF AT LEAST 3 GCP AUTOMATIC TARGET RECOGNITION → DENSE POINT CLOUD → EDIT, ORIENTATE, SCALE & GEOREFERENCING

DENSE POINT CLOUD → 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

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 funciton for the manual computation of coordinates in 3D space.
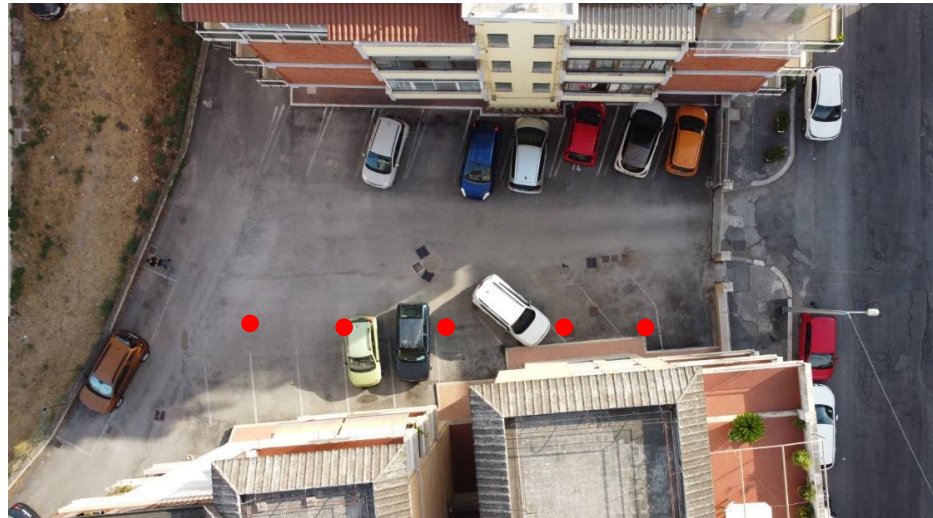
Terrestrial Photo Processing
Images Project - Horizontal Overlapping

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

From Image_Processing folder open Fusion project: **X-PHOTO TERRESTIAL.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
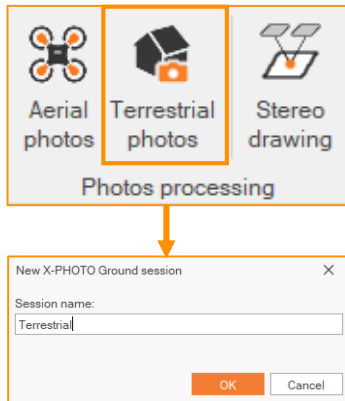
From Survey menu it is possible to select **Points** option to visualize the topographic points table and check the GCP (from **TPS_1** to **TPS_7**) position from the corresponing images

Photo Processing
Imaging Menu

PHOTO PROCESSING is available from Imaging menu, select **Terrestial photo** and enter **Session Name**
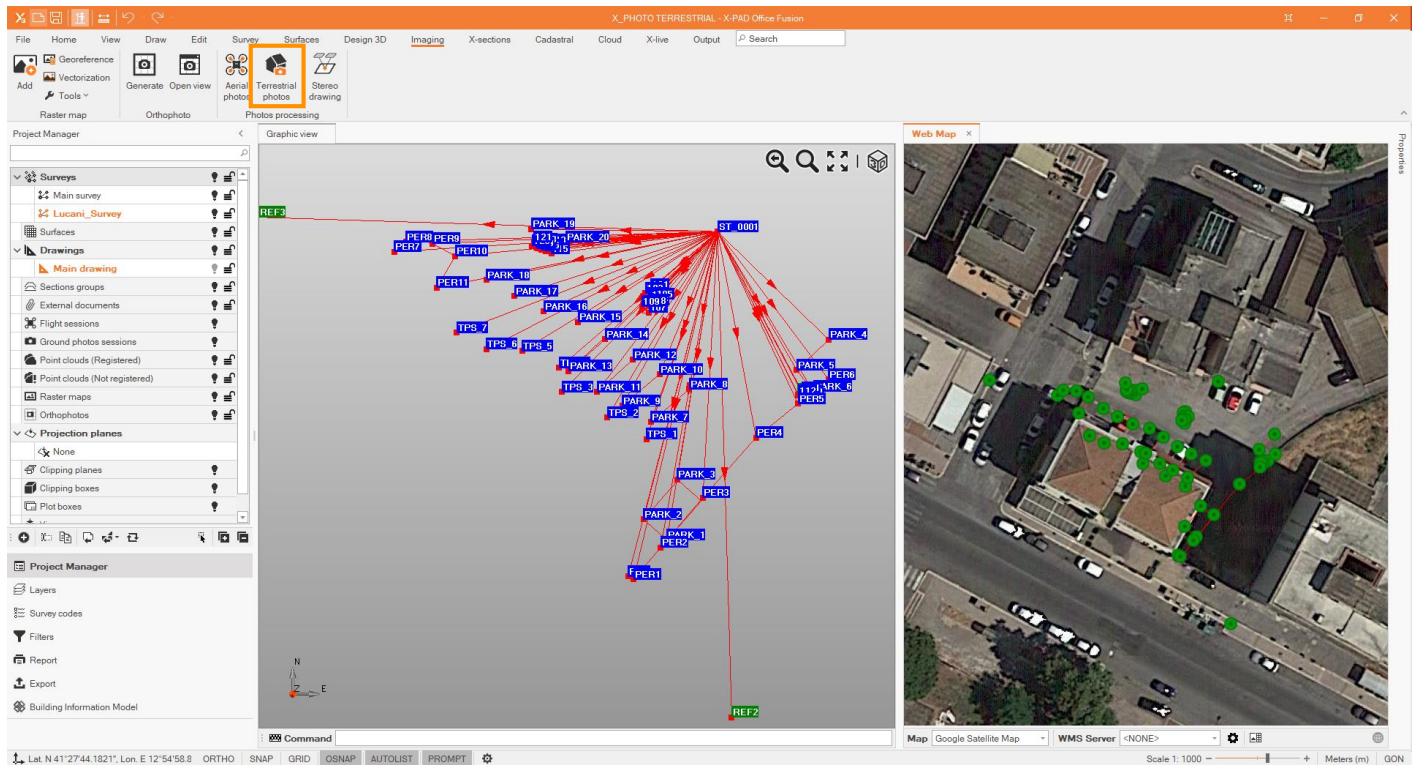
Starting Data — Camera Orientation — GCP — Optimise Orientation — Elaborations

Terrestrial Photo Processing

Images

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

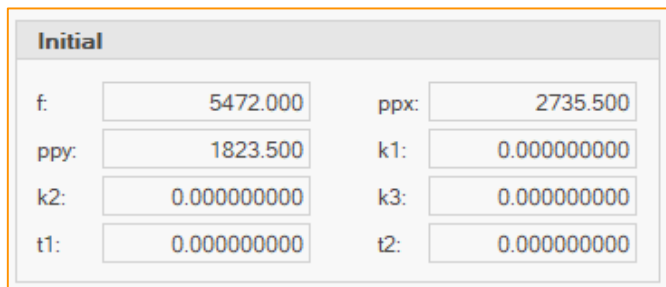Other images formats are:
JPG, BMP,PNG

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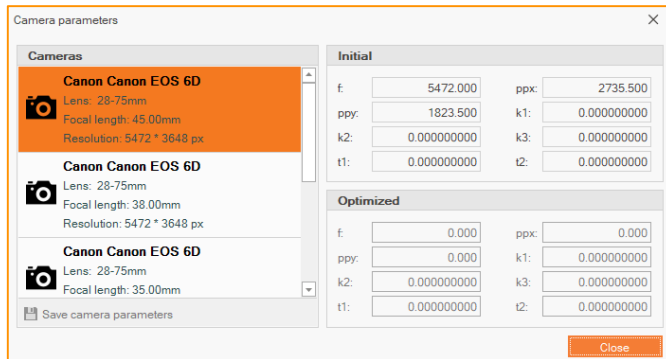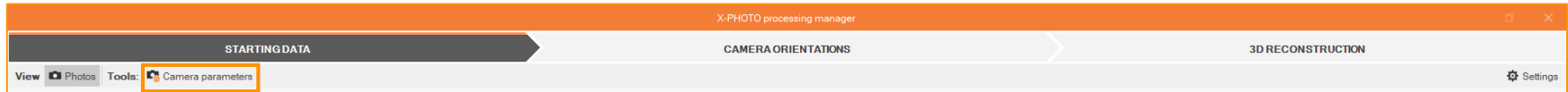
If the camera used is already in our list of camera with calibration parameters, from **Starting Data** menu it is possible to select **Camera parameters** and check the initial parameters for the current camera.
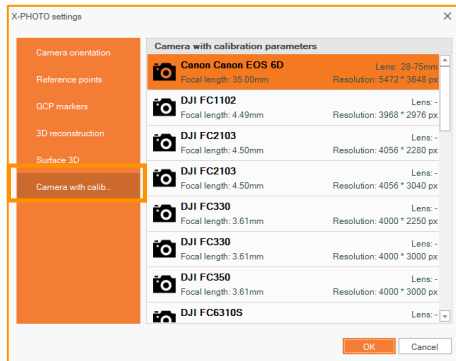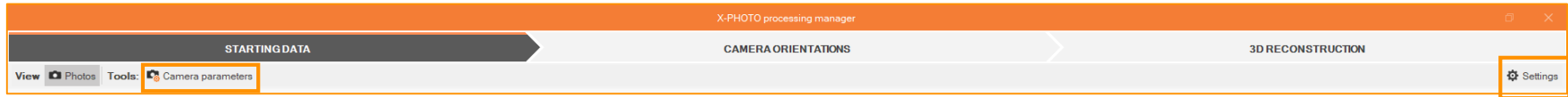

k1, **k2**, **k3**: radial distorsion
t1, **t2**: tangential distorsion
ppx, **ppy**: principal point x and y
(pixels refers to image angles)
f: focal lenght

Starting Data

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

Starting
Data

Terrestrial Photo Processing

Settings

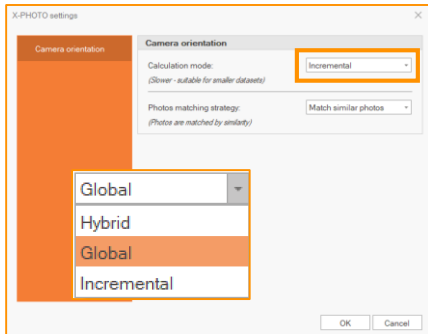From main menu click on **Settings** to set the default parameters for each X-Photo menu and tools
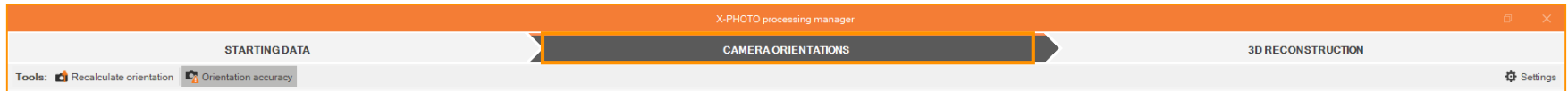

Starting Data

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

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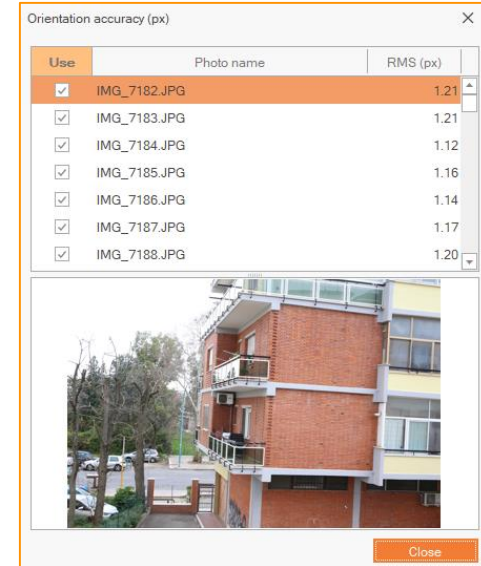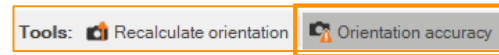
CALCULATION MODE
Different options are available with calculation algorithms based on the dataset

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

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

Starting Data

Camera Orientation

Terrestrial Photo Processing

Reference Points

Load of Reference Points and Check points; X-PAD Fusion topographic points can be use

STARTING DATA

View 📷 Photos ◆ Reference points Tools: 📷 Camera parameters

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

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 define the Coordinate System only from the main interface of X-PAD Fusion using Survey option from the Survey menu

Starting Data

Terrestrial Photo Processing

Reference Points

Load of Reference Points and Check points; X-PAD Fusion topographic points can be use
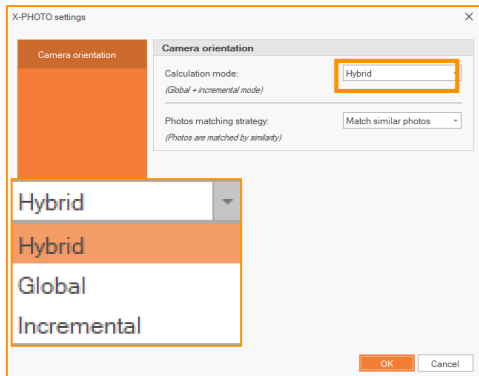
Terrestrial Photo Processing

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
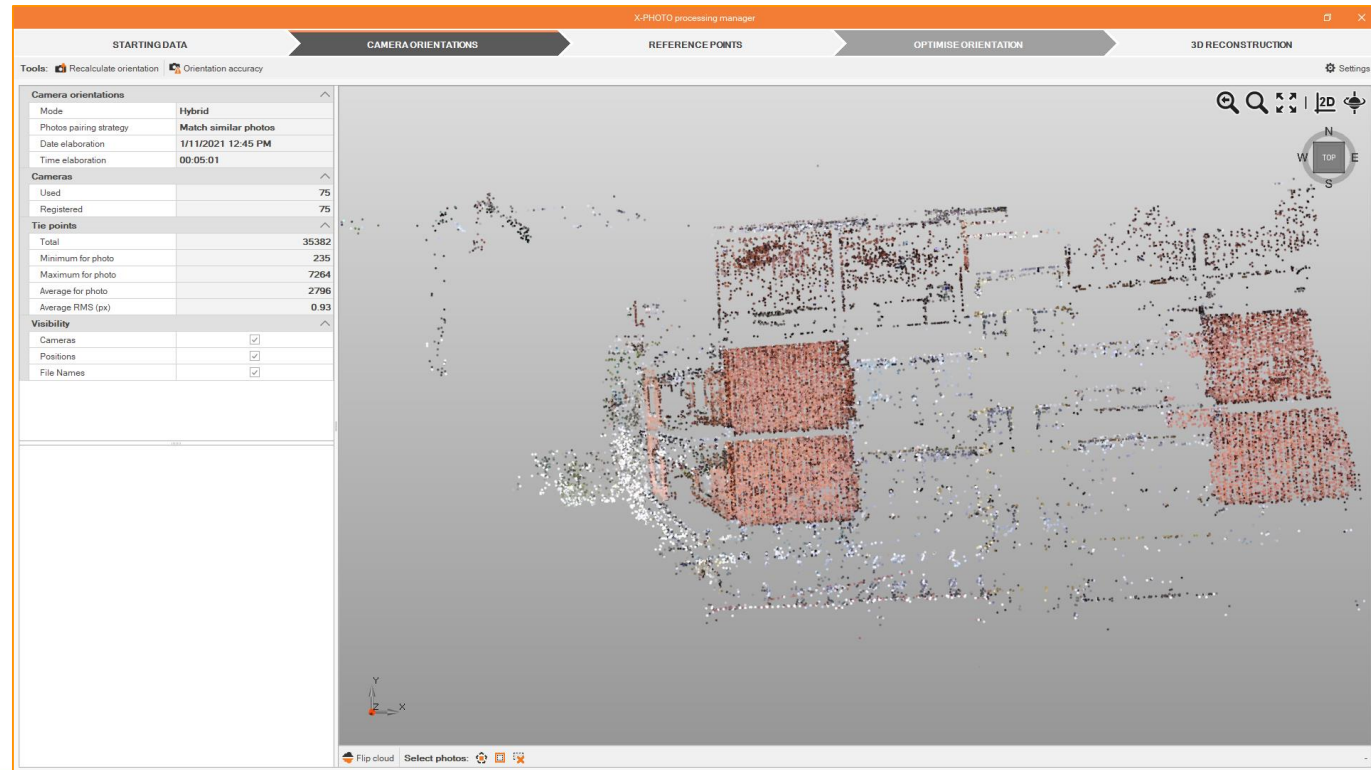

Hybrid
Global+Incremental

Global
Faster - suitable for larger database

Incremental
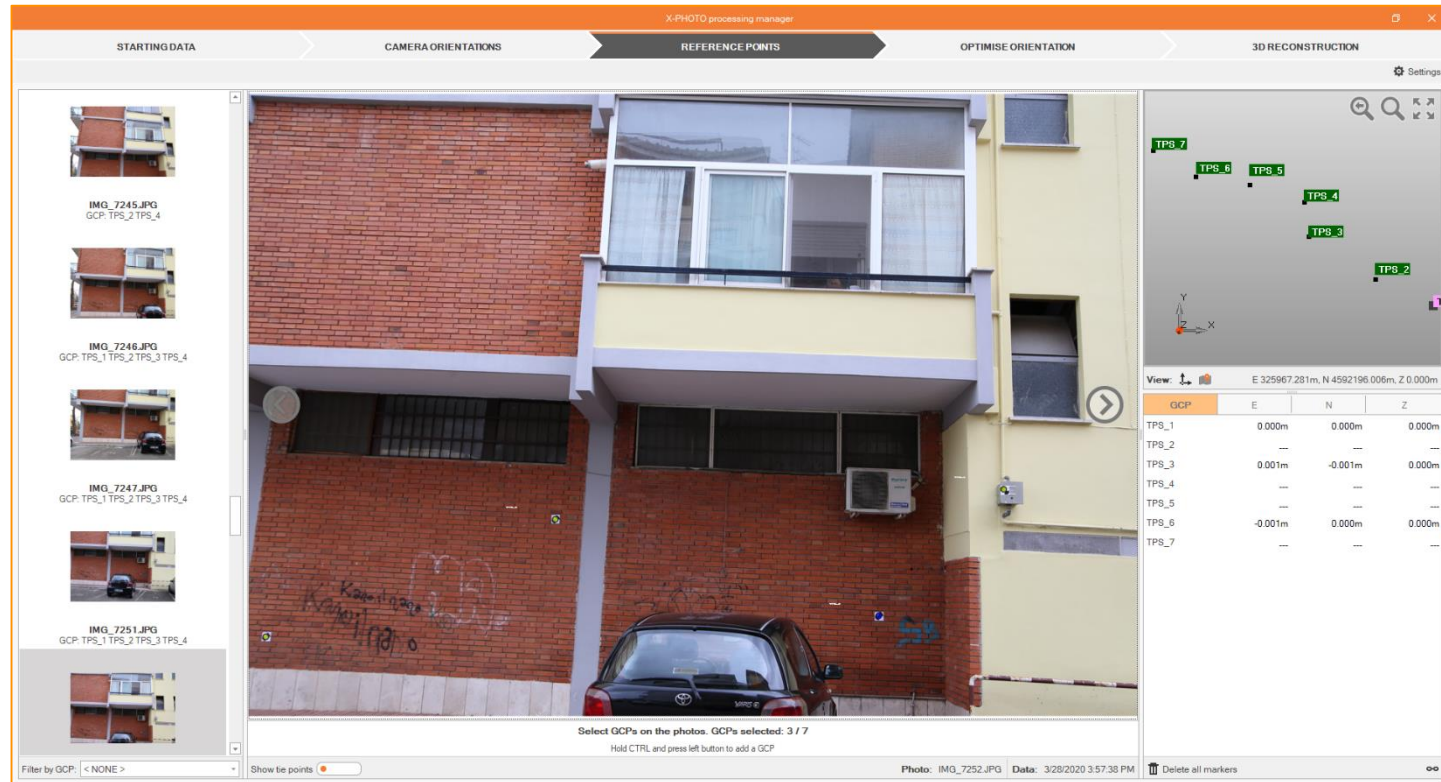Slower - suitable for smaller database
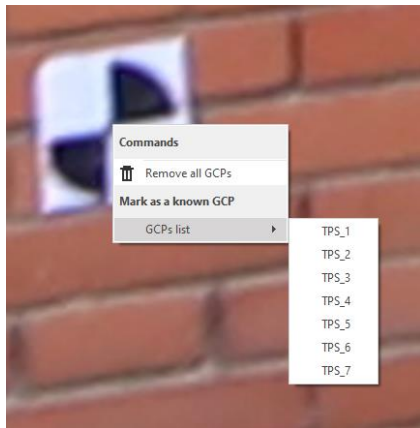
Starting Data

Camera Orientation

Terrestrial Photo Processing
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

It is also possible to press right button and select the GCP from the list to mark the GCP as a known GCP

Starting Data — Camera Orientation — GCP
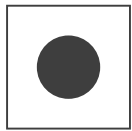
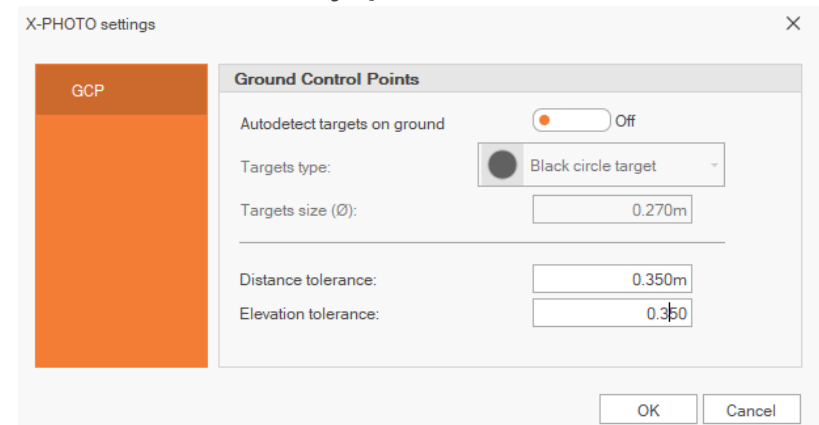# Terrestrial Photo Processing

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**

Starting Data — **Camera Orientation** — **GCP**

Terrestrial Photo Processing

Optimise Orientation

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

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

Starting Data — Camera Orientation — GCP — Optimise Orientation
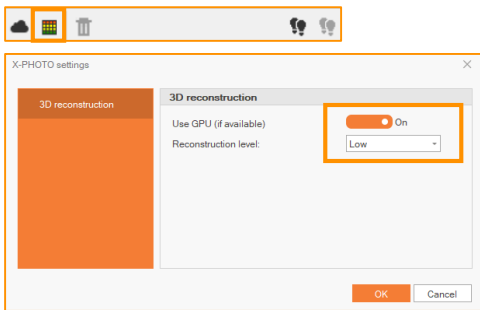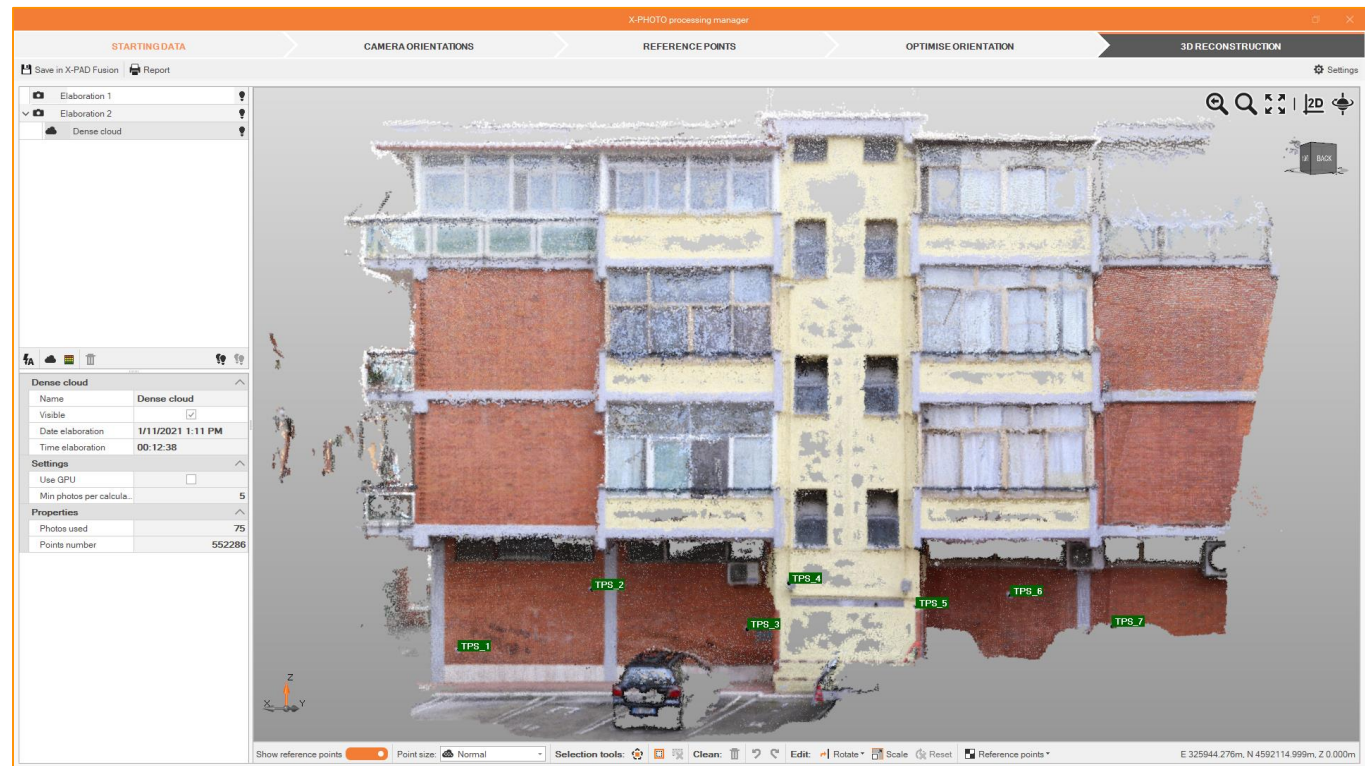
Terrestrial Photo Processing

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   GCP   Optimise Orientation   Elaborations

Terrestrial Photo Processing

3D Reconstruction

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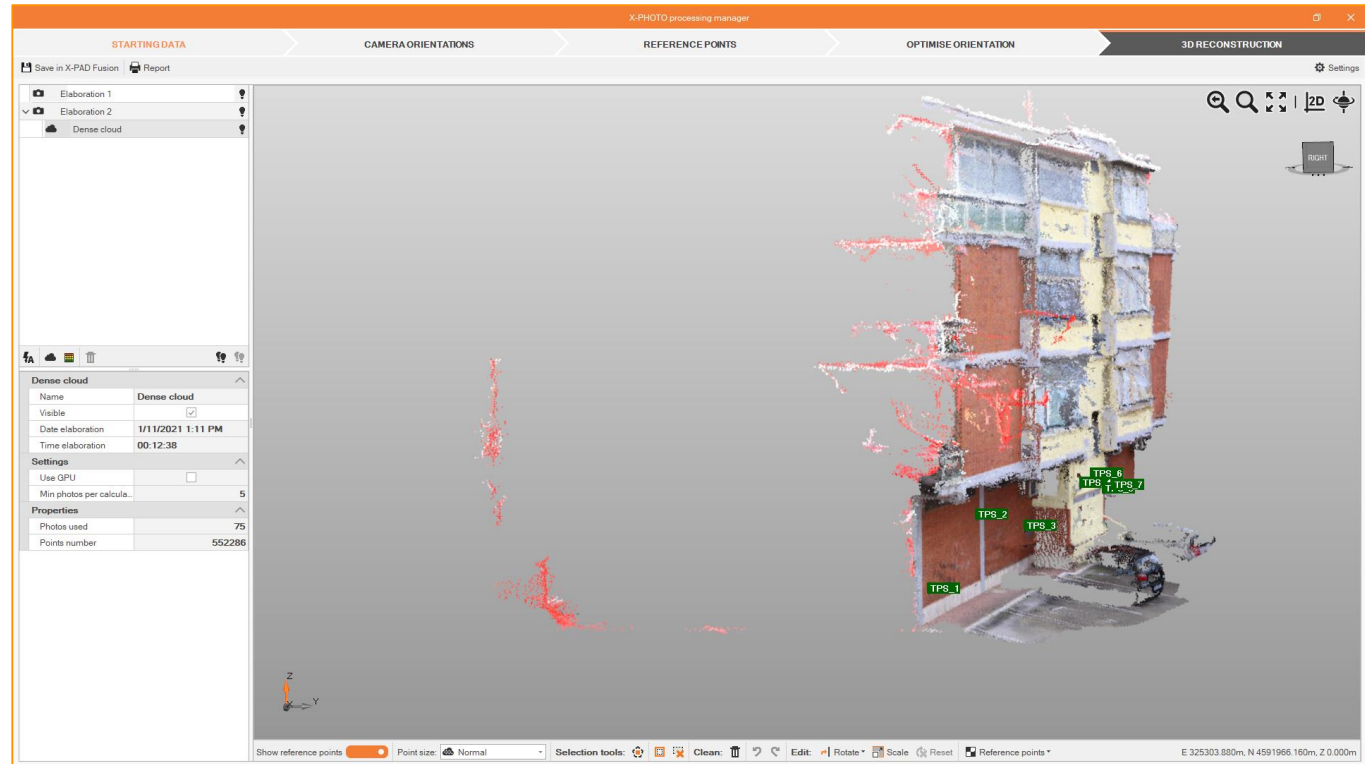
Reference Points and Point Cloud visualization

Selection tools available to **clean Point Cloud**

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

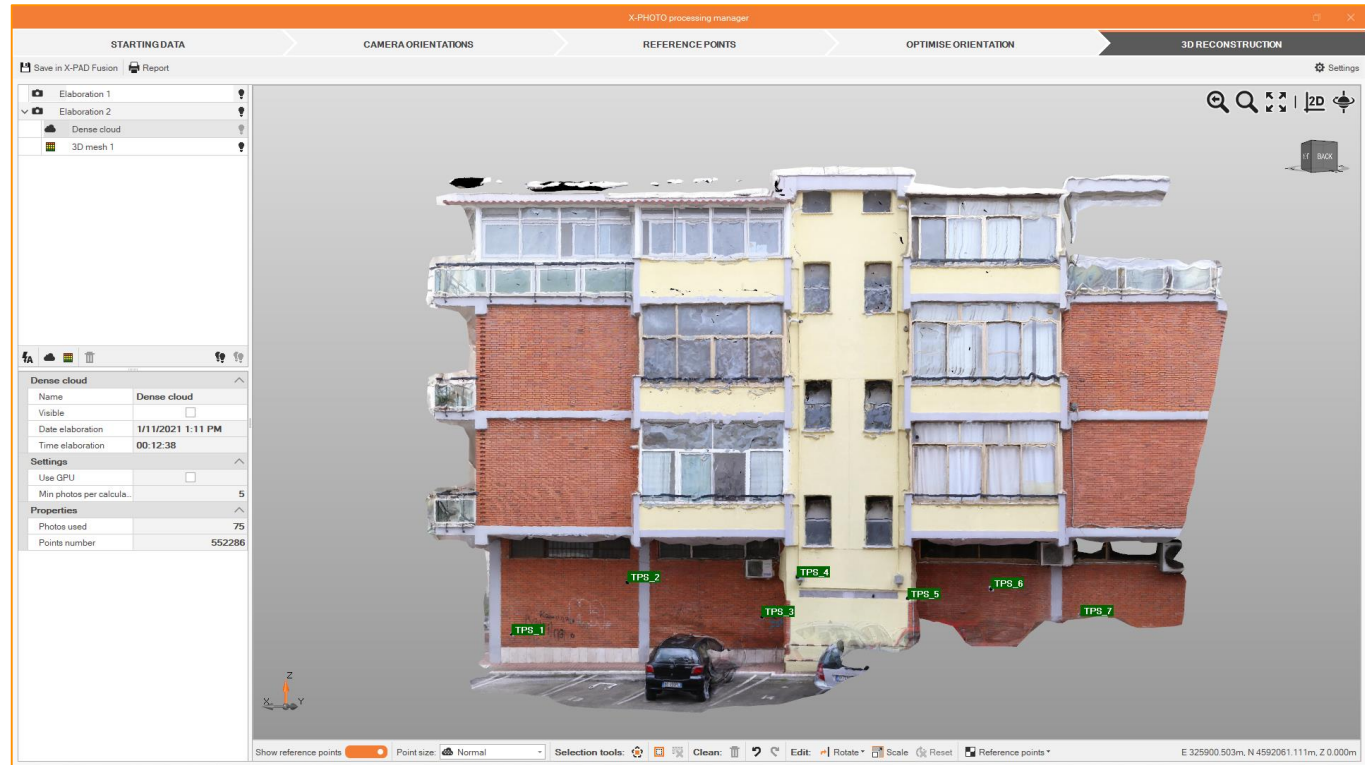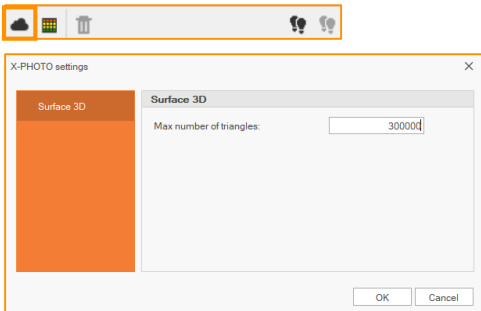Starting Data — Camera Orientation — GCP — Optimise Orientation — Elaborations

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 — GCP — Optimise Orientation — Elaborations
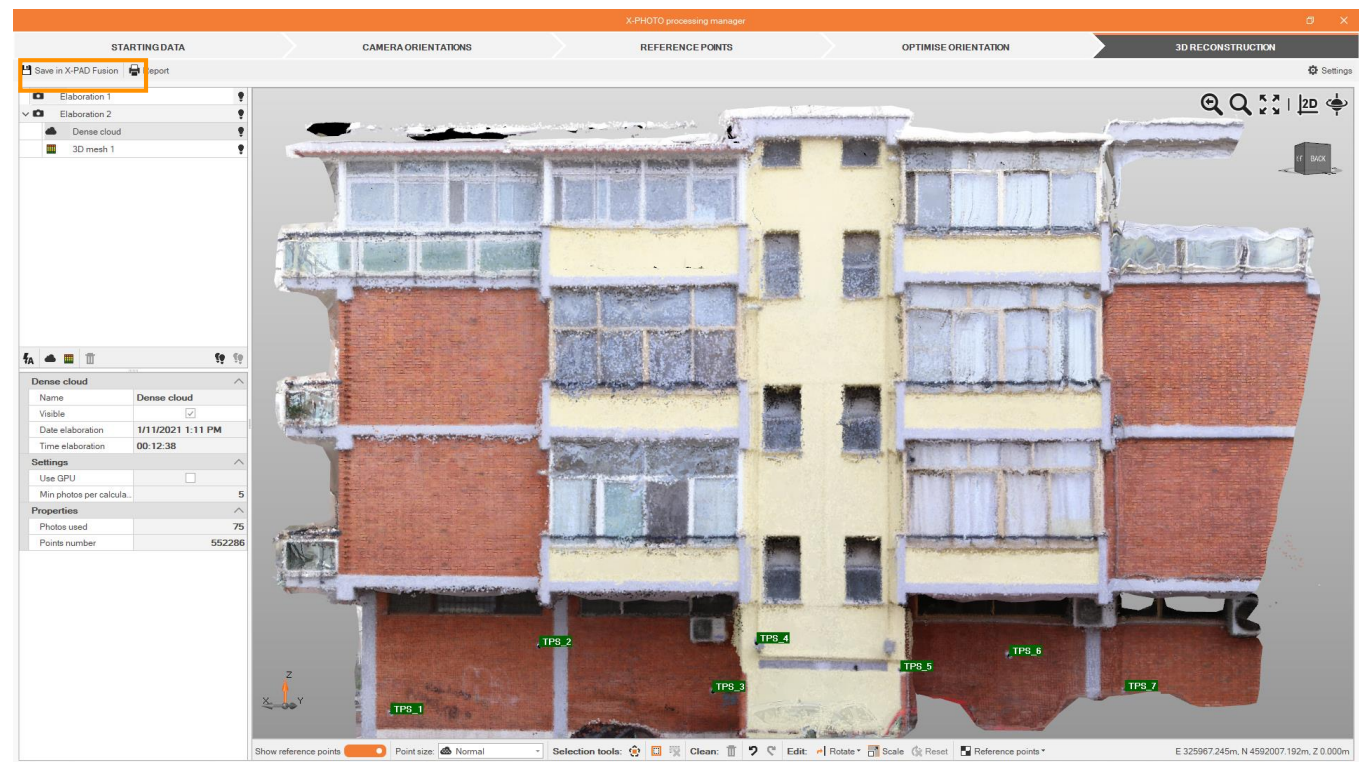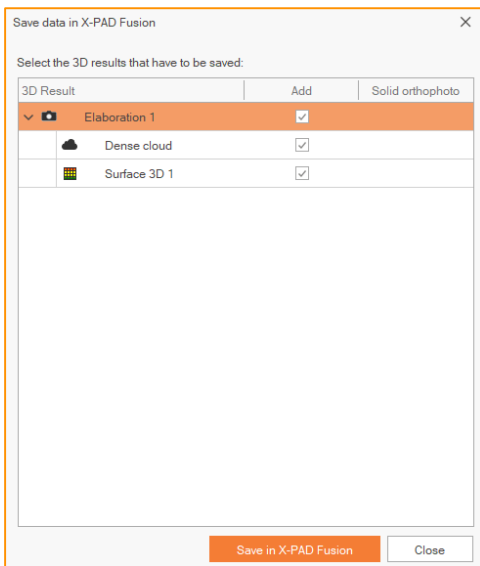
Terrestrial Photo Processing
Save Elaboration

From main menu it's possible select **Save data in X-PAD Fusion** and select the 3D results that have to be saved
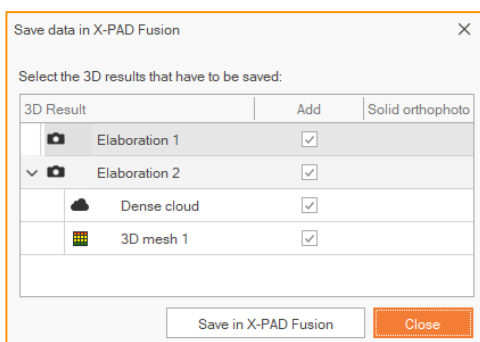
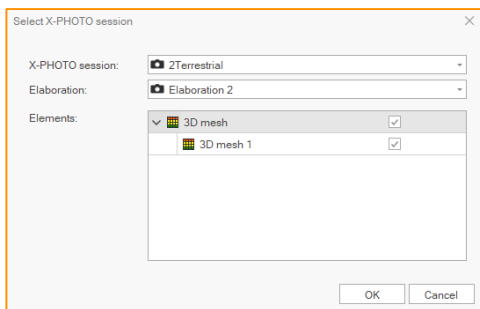# Terrestrial Photo Processing

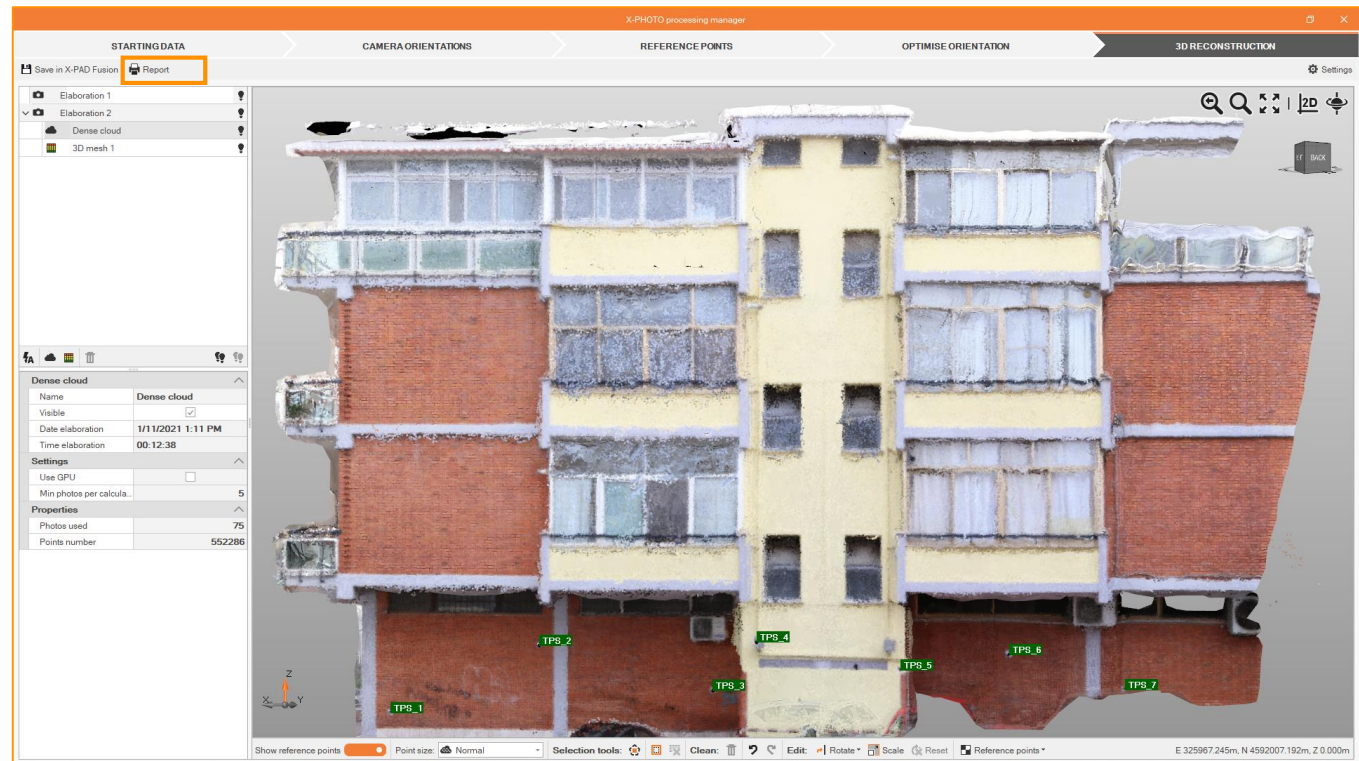## Save Elaboration - Report

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**
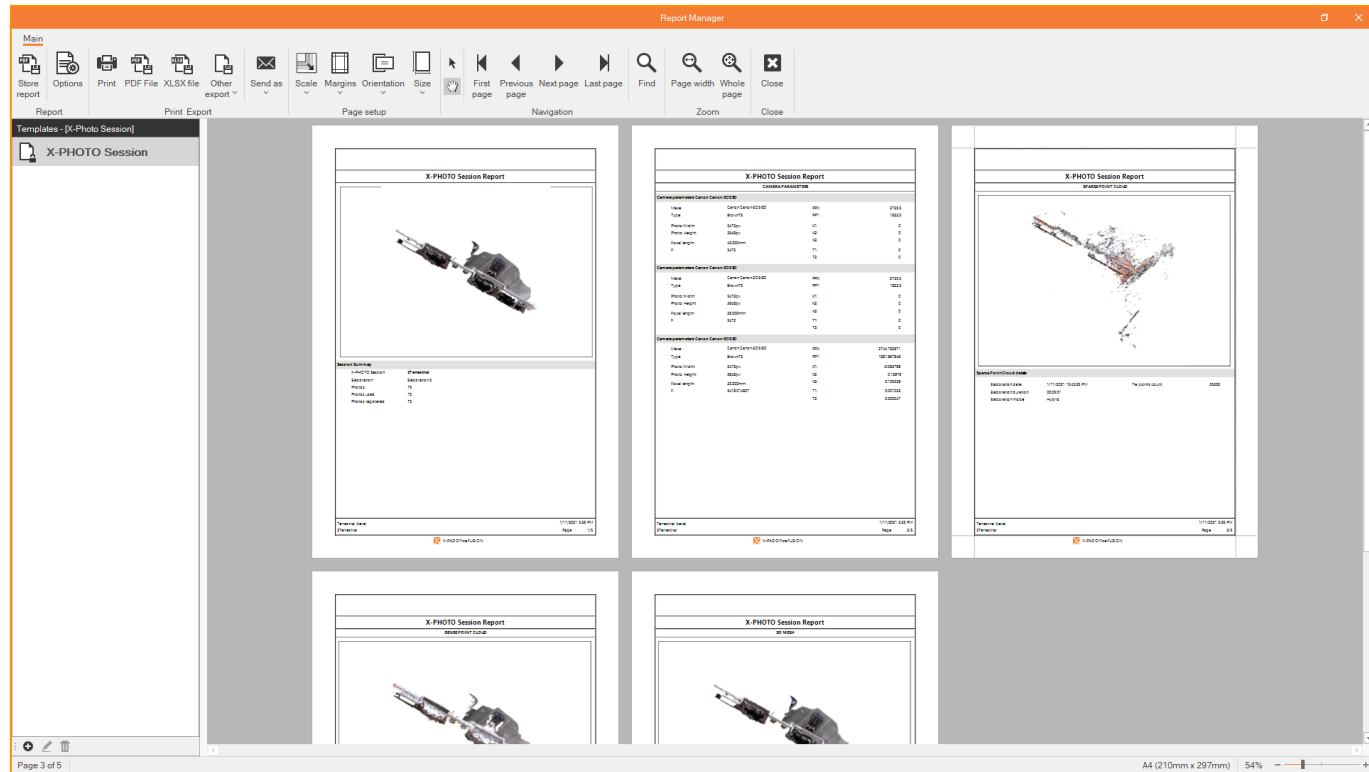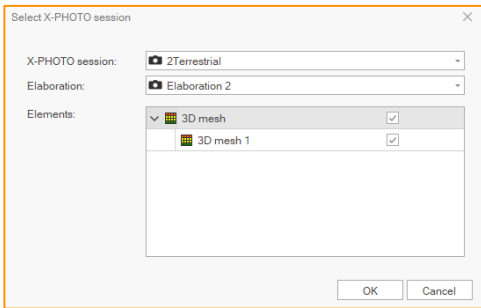

Save Data

Report

Terrestrial Photo Processing

Report

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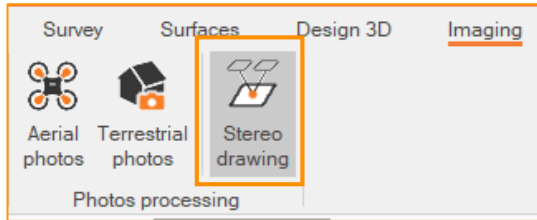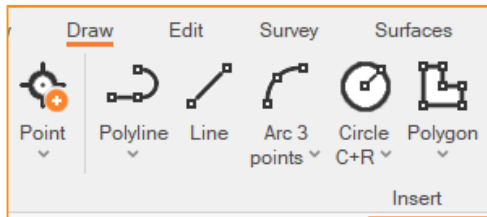
Stereo Drawing
X-Photo Drawing tools

Based on analytical photogrammetry process we can use the Stereo Drawing funciton 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