Tutorial (Intermediate level): Orthophoto and DEM Generation with Agisoft PhotoScan Pro 0.8.5

Add photos

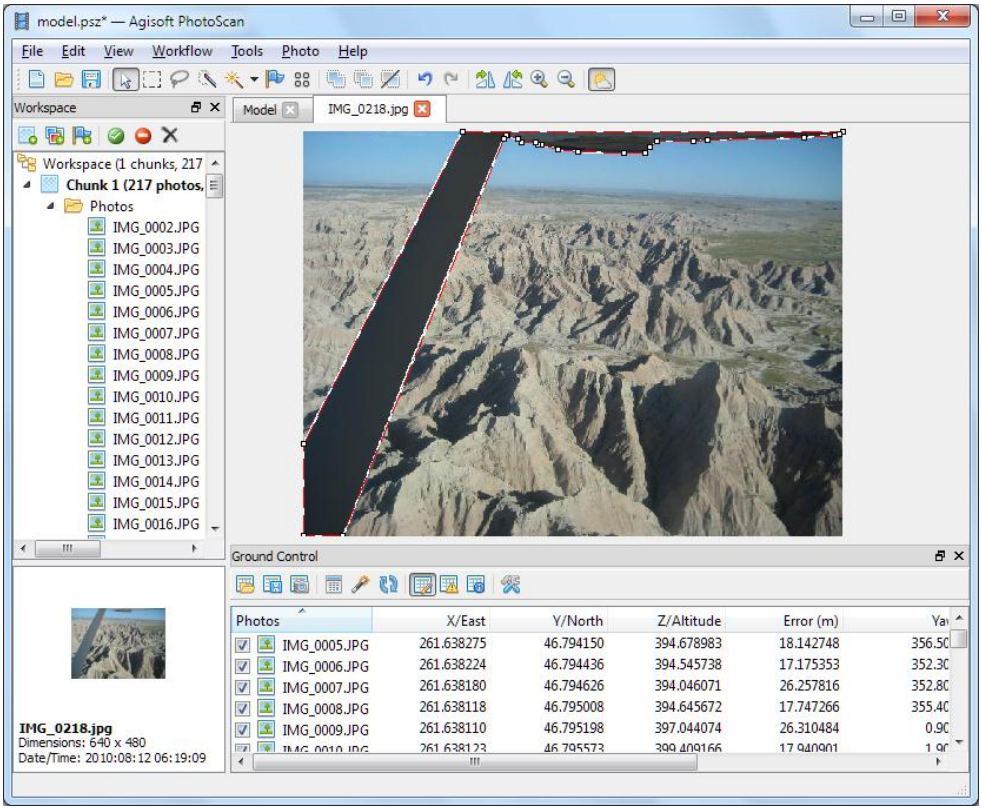
To add photos select the *Add Photos*... command from *Workflow* menu or click *Add Photos* button on *Workspace* toolbar. In the *Add Photos* dialog browse the source folder and select files to be processed. Click *Open* button.

Mask photos

If loaded photos contain areas or objects NOT to be reconstructed (clouds, smoke, moving objects, water drops on lens, blurry or distorted areas, etc.) it is recommended to apply masks to them.

Masks in PhotoScan are represented by contours bounding certain image regions. Modification of the current mask is performed in *Photo View* through adding or subtracting selections. To switch to the *Photo View* double-click on the corresponding photo in the *Workspace* or *Photo* pane. To create selection use one of the supported selection tools (available from the *Toolbar* or *Photo* menu). The selection wouldn't be incorporated in the current mask until it is merged with the mask using *Add Selection* or *Subtract Selection* buttons from the *Toolbar*.

Masked areas could be ignored at *Align Photos* processing stage (Check *Constrain features by mask* option in *Align Photos* dialog) and are always ignored at *Build Model* and *Build Texture* stages.



Add ground control

At this step coordinate system for the future model is set using camera positions.

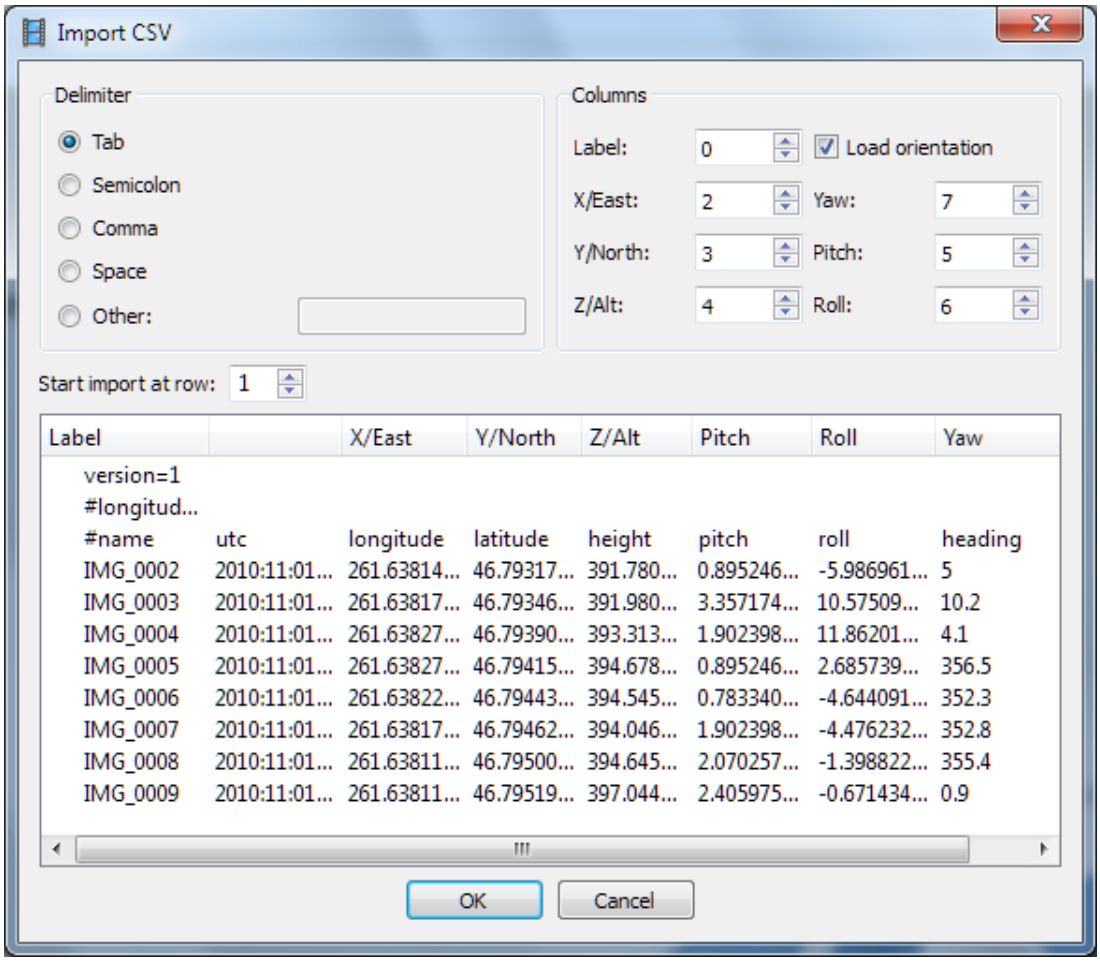
Note: If camera positions are unknown this step could be skipped. The align photos procedure, however, would take more time in this case.

Open *Ground Control* pane using the corresponding command from the *View* menu.

Click *Import* button on the *Ground Control* pane toolbar and select file containing camera positions information in the *Open* dialog.

The easiest way is to load simple character-separated file (*.txt) that contains x- and y- coordinates and height for each camera position (camera orientation data, i.e. pitch, roll and yaw values, could also be imported, but the data is not obligatory).

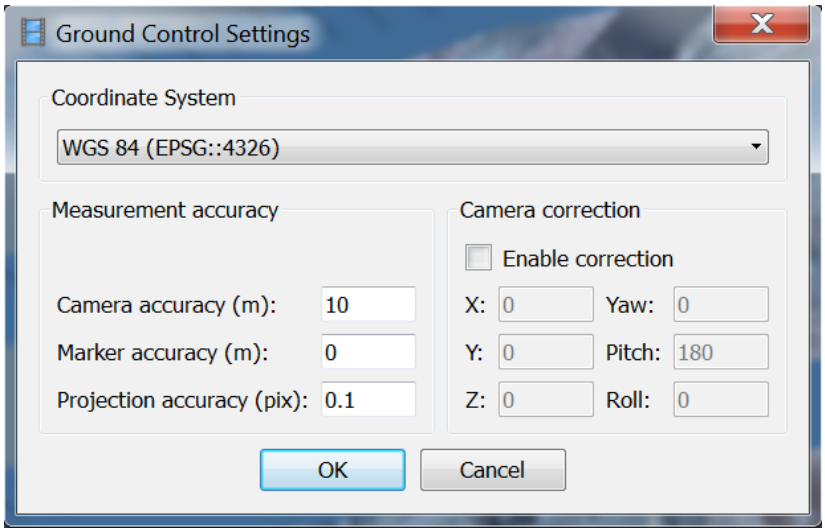
In *Import CSV* dialog indicate the delimiter according to the structure of the loading file and select the row to start loading from. Note that rows are numbered starting from zero; # character indicates a commented line that is not counted while numbering the rows. Indicate for the program what parameter is specified in each column through setting correct column numbers in the *Columns* section of the dialog. Columns are numbered from zero as well. Check your settings in the sample data field in *Import CSV* dialog.



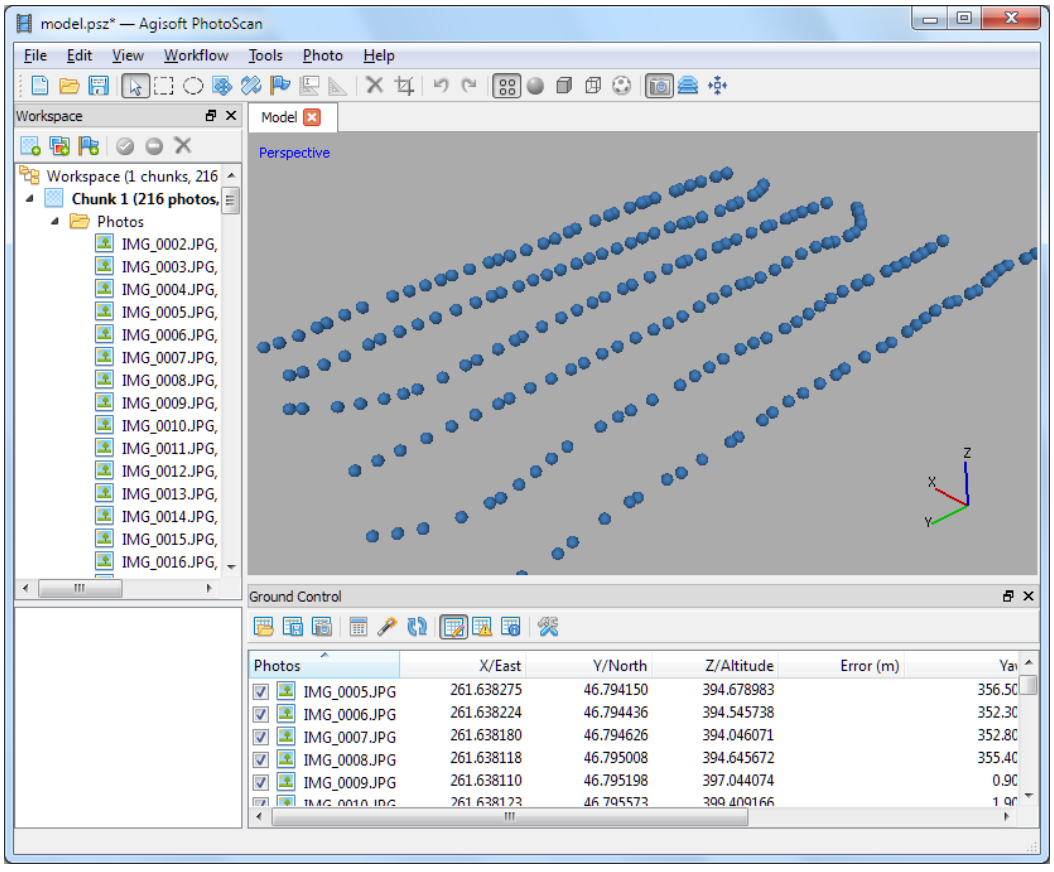
Click *Open* button. The data will be loaded into the *Ground Control* pane.

Import EXIF Ground Control pane toolbar button can also be used to load camera positions information if EXIF meta-data is available.

Then click on the *Settings* button in the *Ground Control* pane and in the *Ground Control Settings* dialog select corresponding coordinate system from the list.



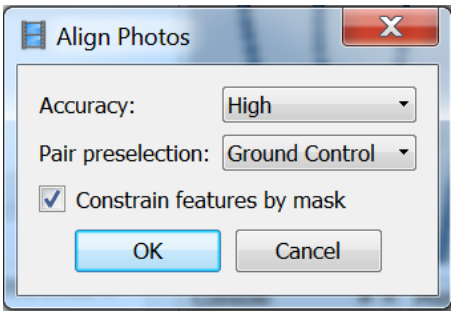
Click *OK* and camera positions will be marked in *Model View* using their geographical coordinates:



Align photos

At this stage PhotoScan refines the camera position for each photo and builds the point cloud model.

Select *Align Photos* command from the *Workflow* menu.



Set the following recommended values for the parameters in the *Align Photos* dialog:

Accuracy: *High* (higher accuracy setting helps to obtain more accurate camera positions estimates. Lower accuracy setting can be used to get rough camera positions in a shorter period of time)

Pair preselection: *Ground Control* (in ground control preselection mode PhotoScan matches only overlapping images, which significantly speeds up the procedure in case of hundreds of photos)

Constrain features by mask: *Enabled* (if any masks are applied). Otherwise, *Disabled*

Click *OK* button to start photo alignment.

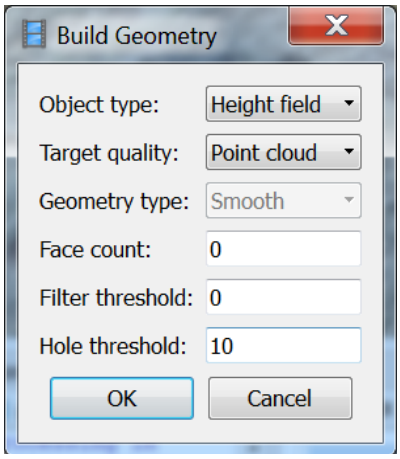
Place markers

Markers are used to optimize camera positions and orientation data, which allows for better model reconstruction results.

To generate quality orthophoto at least 10 ground control points (GCP) should be marked evenly within the area to be processed.

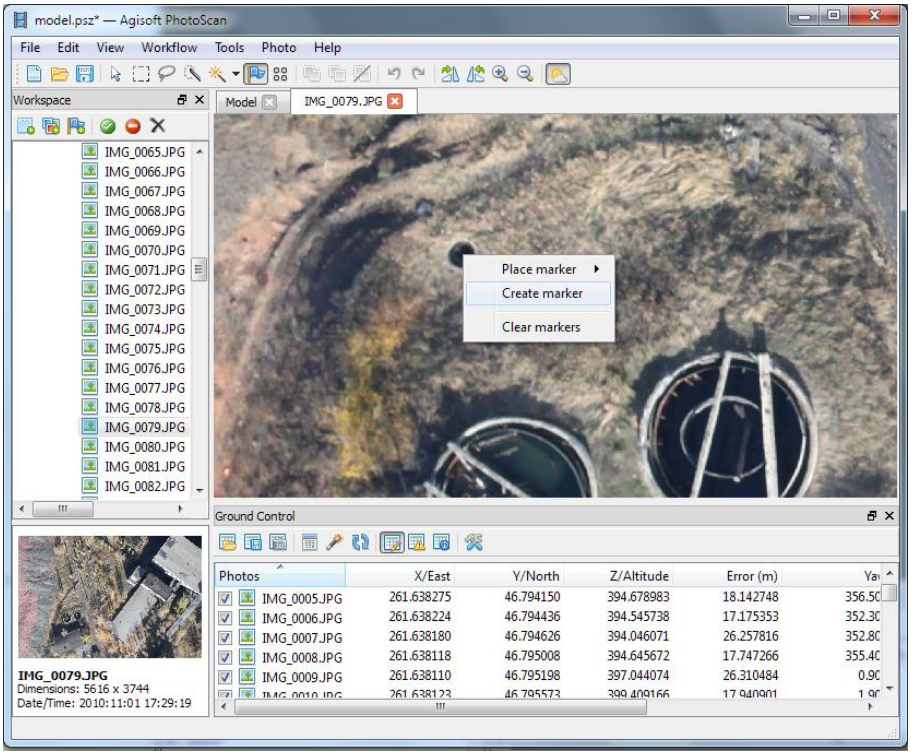
To be able to follow guided marker placement approach (that would be faster and easier) you need to reconstruct geometry first.

Select *Build Geometry*... command from the *Workflow* menu and specify following parameters in the *Build Geometry* dialog:

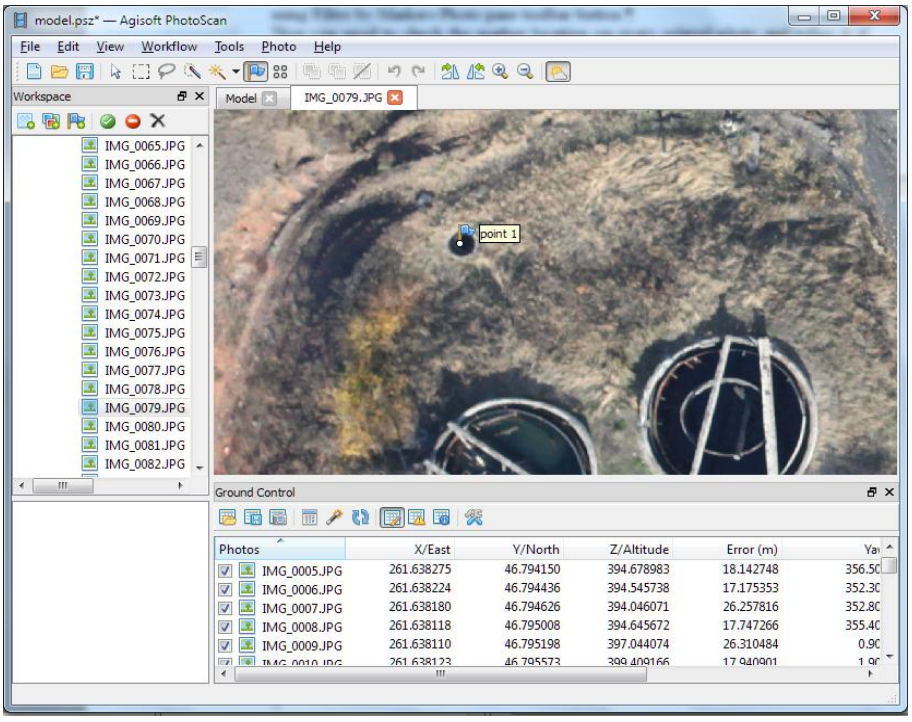


Click *OK* button.

Then, when the geometry is built (it usually takes a few seconds), open a photo where a GCP is visible in *Photo View* double-clicking on its icon in the *Photo* pane. Switch to marker editing mode using *Edit Markers* toolbar button. Zoom in to locate the GCP on the photo and place a marker in the corresponding point of the image using *Create Marker* command from the photo context menu available on right-click on the opened photo in the corresponding position:



Select the marker on the *Ground Control* pane. Then filter images in *Photo* pane using *Filter by Markers Photo* pane toolbar button.

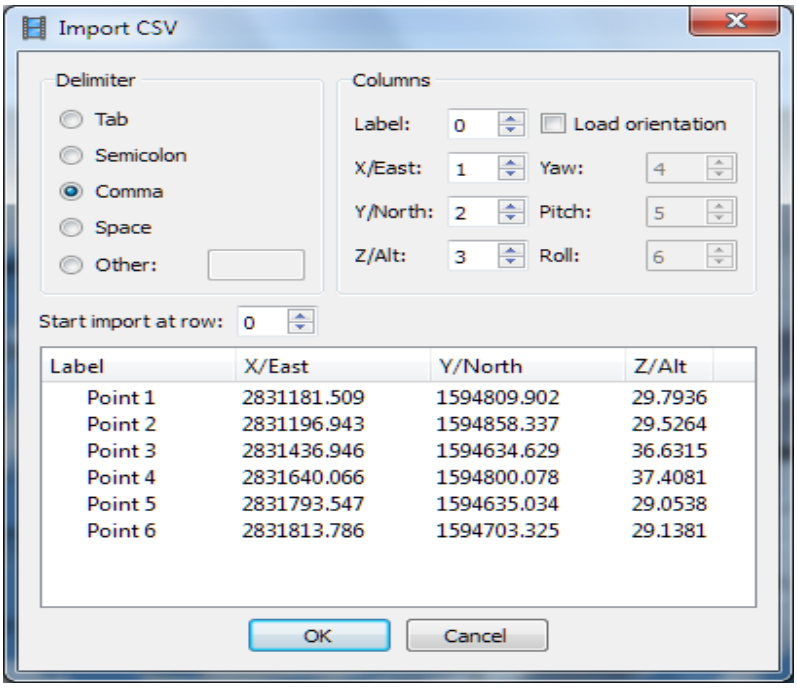


Now you need to check the marker location on every related photo and refine its position if necessary to provide maximum accuracy. Open each photo where the created marker is visible. Zoom in and drag the marker to the correct location using the mouse in the *Edit Markers* mode.

Repeat the described step for every GCP.

Finally, import marker coordinates from a file. Click *Import* button on the *Ground Control* pane toolbar and select file containing GCP coordinates data in the *Open* dialog. The easiest way is to load simple character-separated file (*.txt) that contain markers name, x-, y- coordinates and height.

In *Import CSV* dialog indicate the delimiter according to the structure of the file and select the row to start loading from. Note that rows are numbered starting from zero; # character indicates a commented line that is not counted while numbering the rows. Indicate for the program what parameter is specified in each column through setting correct column numbers in the *Columns* section of the dialog. Columns are numbered from zero as well. Check your settings in the sample data field in *Import CSV* dialog:



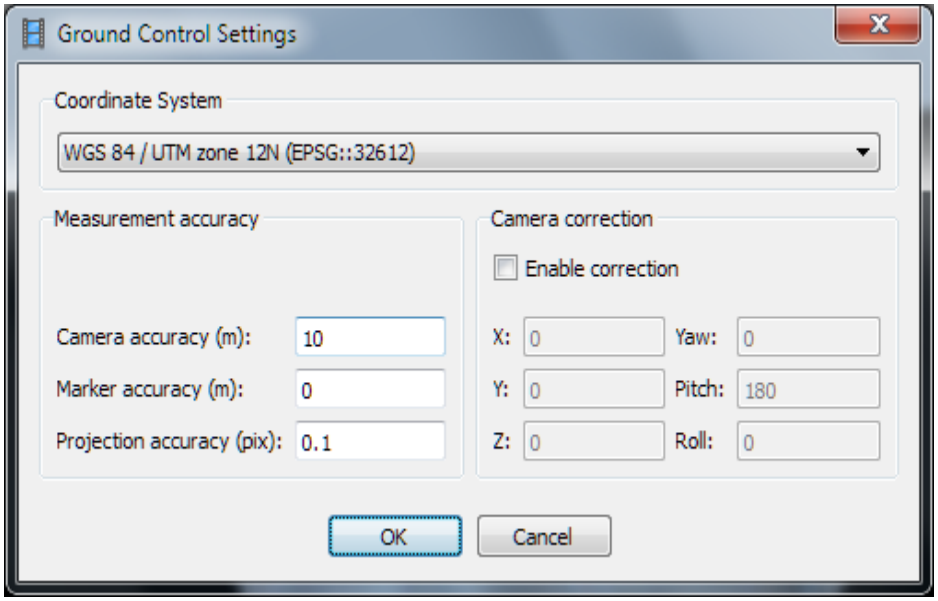
Click *OK* button. The data will be loaded into the *Ground Control* pane.

Optimize photo alignment

To achieve higher accuracy in calculating camera external and internal parameters and to correct possible distortion (e.g. “bowl effect” and etc.) optimization procedure should be run. This step is especially recommended if the ground control point coordinates are known almost precisely (several centimeters accuracy) (marker based optimization procedure).

Click the *Settings* button in the *Ground Control* pane and in the *Ground Control Settings* dialog select corresponding coordinate system from the list according to the GCP coordinates data.

Set the following values for the parameters in *Measurement accuracy* section:

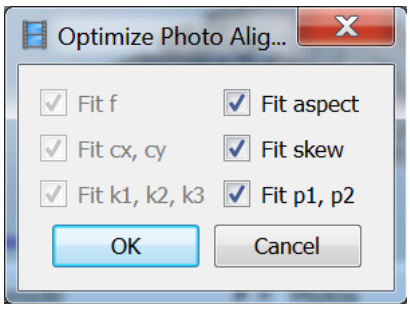


Camera accuracy: *10*
Marker accuracy: *0* (PhotoScan will assume that markers coordinates are known exactly, which can help to obtain more accurate results. The marker accuracy is recommended to be set at 0 value if the real marker accuracy is within 0.02 m)
Projection accuracy: *0.1*

Click *OK* button.

On the *Ground Control* pane uncheck all photos and check the markers to be used in optimization procedure. The rest of the markers that are not taken into account can serve as control points to evaluate the optimization results.

Click *Optimize* button on the *Ground Control* pane toolbar.

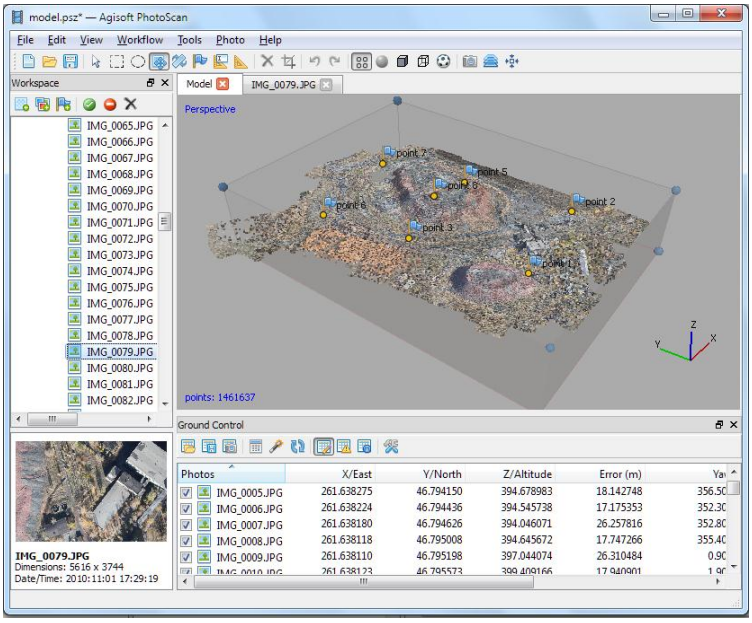


Select camera parameters you would like to optimize. Click *OK* button to start optimization process.

Set bounding box

This step is optional since PhotoScan automatically calculates bounding box dimensions and location. It is recommended, however, to check if any correction is needed as geometry reconstruction procedure is applied only to the area inside the bounding box and odd points exclusion may speed up the process.

Bounding box is resizable and rotatable with the help of *Resize Region* and *Rotate Region* tools from the *Toolbar*.

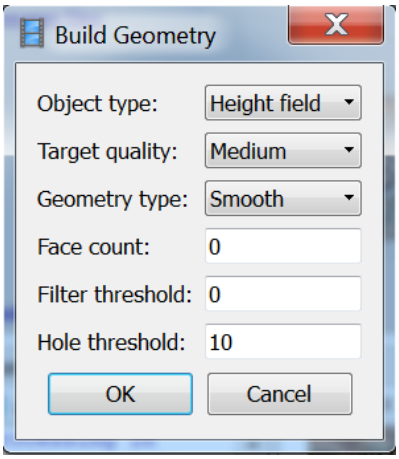


Important: *The red-colored side of the bounding box indicates the plane that would be treated as ground plane and has to be set under the model.*

Build geometry

3D model reconstruction is a computationally intensive operation, it can take a long time, depending on the quantity and resolution of loaded photos and selected target quality.

Select *Build Geometry* command from the *Workflow* menu.



Set the following recommended values for the parameters in the *Build Geometry* dialog:

Object type: *Height-field*
Target quality: *Medium* (higher quality takes quite a long time and demands more computational resources)
Geometry type: *Smooth* (smooth geometry type means that nearly all the holes will be filled) or *Sharp* (sharp geometry type means exact reconstruction method without any additional geometry)
Face count: *0* (it means that the maximum face number will not be restricted)
Filter threshold: *0*
Hole threshold: *10*

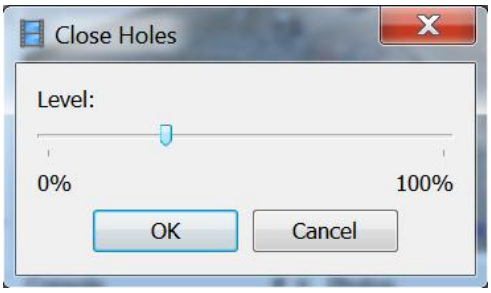
Click *OK* button to start building geometry.

Edit geometry

PhotoScan tends to produce 3D models with excessive geometry resolution. That's why it is strongly recommended to decimate mesh to avoid unreasonable time-consumption at orthophoto export stage.

To decimate 3D model select *Decimate Mesh*... command from the *Tools* menu.
In the *Decimate Mesh* dialog specify the target number of faces that should remain in the final model. For orthophoto generation task it is recommended to downsize the number of faces to several millions. Click *OK* button.

If the geometry was built with sharp type setting, to generate holeless orthophoto at the final stage use *Close Holes*... command from the *Tools* menu at geometry editing

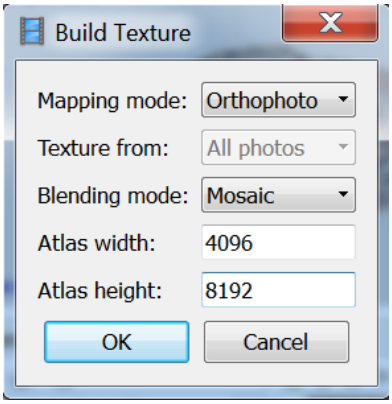


stage. In *Close Holes* dialog select the size of the largest hole to be closed (in percentage of the total model size).

Click *OK* button to start holes closing procedure.

Build texture

This step is not really needed in the orthophoto export workflow, but it might be necessary to inspect a textured model before exporting it or it might be useful for precise marker placement.

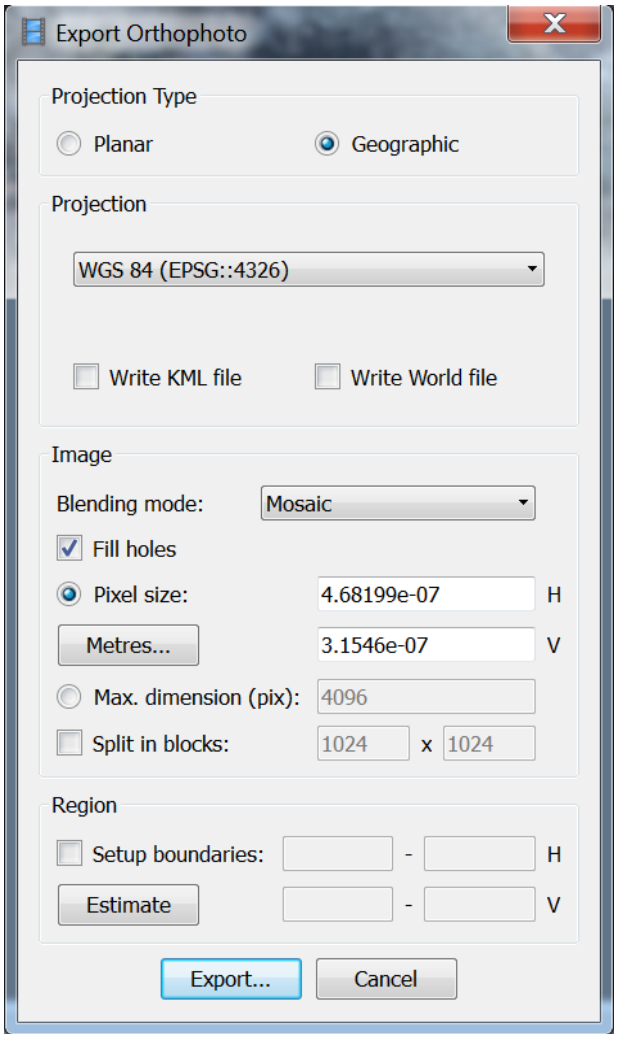


Set the following recommended values for the parameters in the *Build Texture* dialog:
Mapping mode: *Orthophoto*
Blending mode: *Mosaic*
Atlas width and height: *4096-8192* (it is not reasonable to use higher values for orthophoto generation)

Click *OK* button to start building texture.

Generate orthophoto

Select *Export Orthophoto -> Export JPEG/TIFF/PNG* command from *File* menu.



Set the following recommended values for the parameters in the *Export Orthophoto* dialog:

Projection type: *Geographic*

Projection: by default the projection set in the *Ground Control Settings* is used

Blending mode: *Mosaic*

Fill holes: if the holes were not closed at edit geometry step, check this option to generate holeless orthophoto

Pixel size: maximum effective resolution is shown by default

Split in blocks: *4096*x*4096* (if the exported area is large it is recommended to enable Split in blocks feature, since the memory consumption is rather high at exporting stage)

Region: set the boundaries of the model's part that should be projected and presented as orthophoto.

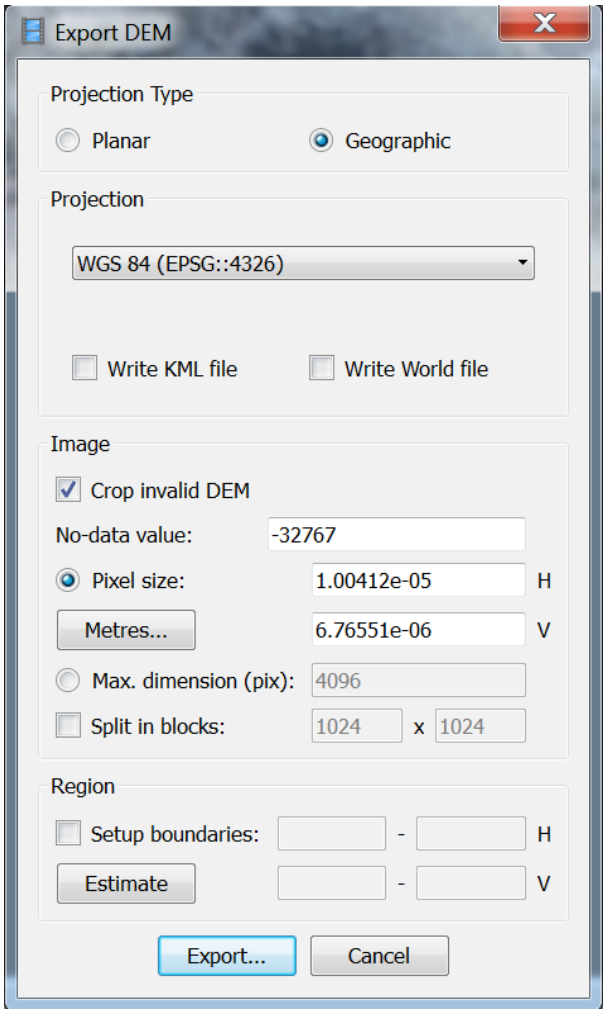
Click *Export...* button and then specify target file name and select type of the exported file (e.g. GeoTIFF). Click *Save* button to start orthophoto generation.

Note: If the model is to be located in Google Earth Standard version, *Write KML file* option should be checked in *Export Orthophoto* dialog. The reason is that Google Earth Standard version is unable to extract georeferencing data from a GeoTIFF file, so georeferencing information has to be duplicated in a KML file to make it possible for Google Earth Standard version to read it.

Export Google KML option could be chosen in the beginning of the orthophoto generation step (*File- Export Orthophoto -> Export Google KML*). ***Note that this option is active only if the model was georeferenced in WGS 84 datum.*** In fact, Google Earth is able to georeference models only in WGS 84 datum.

Generate DEM

Select *Export DEM* command from *File* menu.



Set the following recommended values for the parameters in the *Export DEM* dialog:

Projection type: *Geographic*

Projection: by default the projection set in the *Ground Control Settings* is used

Crop invalid DEM: check this option to crop the regions with unreliable elevation data, since they are visible on less than two source photos

Pixel size: you can increase the effective resolution compared to the default value

Split in blocks: *4096*x*4096* (if the exported area is large it is recommended to enable Split in blocks feature, since the memory consumption is rather high at exporting stage)

Region: set the boundaries of the model's part that should be presented as DEM.

Click *Export...* button and then specify target file name and select type of the exported file (e.g. GeoTIFF). Click *Save* button to start DEM generation.

Neogeo Co., Ltd. : 98/2 Ladkabang Road, Ladkabang, Ladkabang District,
Bangkok 10520. Thailand. Tel/Fax : +66 (0)2 172 6655 Hotline : +66 (0)80 139 6655
Email : sales@neogeothai.com http://www.neogeothai.com