

Mapping and Aerial Image Processing Software

WORK FLOW

Version 2.9.0

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1. LOAD IMAGES

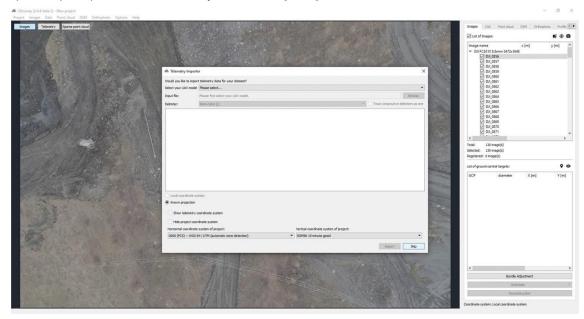
Start 3Dsurvey, select **New project** button and select project images in your folder. Same can be done through **Menubar's Images** - > **Load images**.



When images are loaded, Telemetry importer window pops up.

2. TELEMETRY

Telemetry data is attribute data of your images. This data includes information about the drone's (or camera's) position at the time of recording of images. Adding telemetry data at this stage significantly speeds up the process of Bundle Adjustment/Image Alignment.



For DJI, Yuneec, eBee and falcon drones drones use **Exif data** for Telemetry import.

For drones with the separate log file use one of following options:

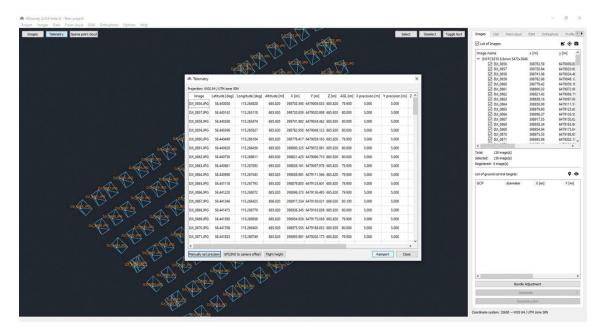
- C-astral Bramor -> *.csv
- MaVinci Sirius Pro -> *.csvExif data (DJI Phantom 4, Inspire 1, eBee, Falcon 8,..)
- Other -> *.csv

For Horizontal coordinate system use the coordinate system that you want your results to be in.

For Vertical coordinate system -> If using non-RTK drone - Use EGM96 Global 15-minute Geoid

If using a RTK drone - Use your appropriate regional Geoid model





Telemetry window pops up, presenting imported data and its transformation to project coordinate system with their accuracy. Click **close**.

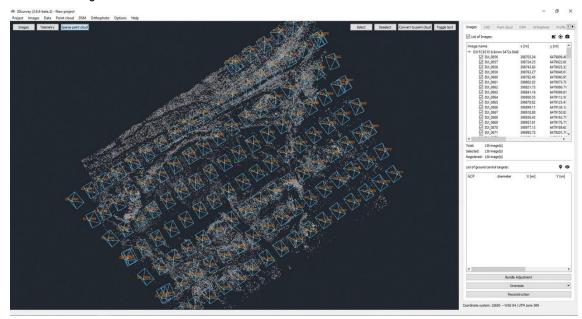
3. BUNDLE ADJUSTMENT

Press **Bundle Adjustment** to start processing the dataset.



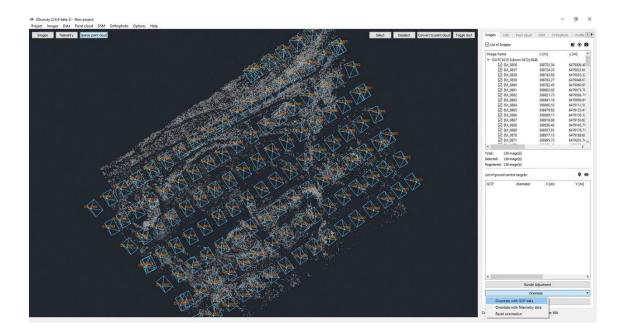
Select **Global** mode of adjustment and click **OK** to start Bundle adjustment. The processing time could be between a couple of minutes and up to several hours. It depends on the number of images and your CPU specifications (number of cores,...)

Once project is bundle adjusted, you can observe several function in the viewer. You can watch *images*, or click *telemetry*, to observe location and orientation (external orientation) of images. *Toggle text*, to view or not image names.



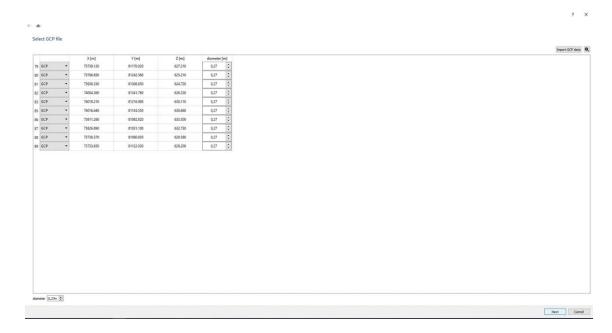
4. ORIENTATION (GEO-REFERENCING)

To geo-reference a project, proceed with **Orientation**. Three options are available depending on your data type.

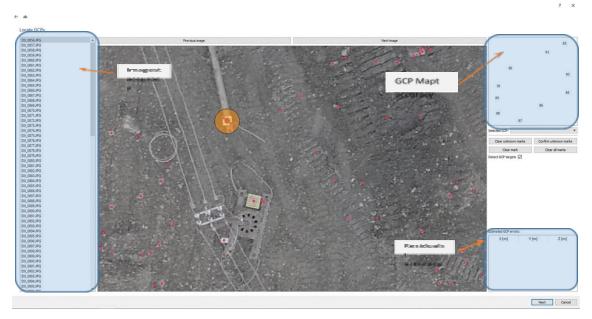


To proceed, click *Orientate with GCP* and follow the Orientation pop-up wizard: First, **select** *ground* **control points** (*.txt) file and click **next**.

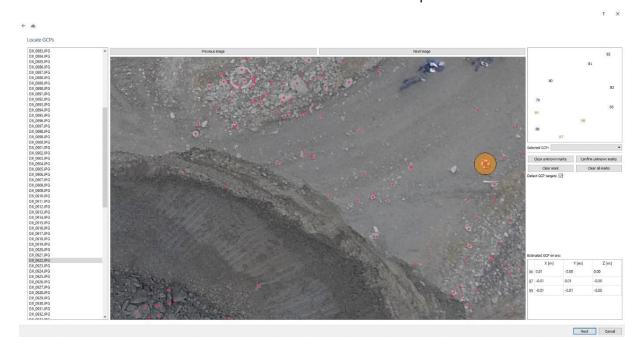
Further select GCP's coordinate system and also project coordinate system in which computed results and data will be transformed. Select *Local coordinate system*.



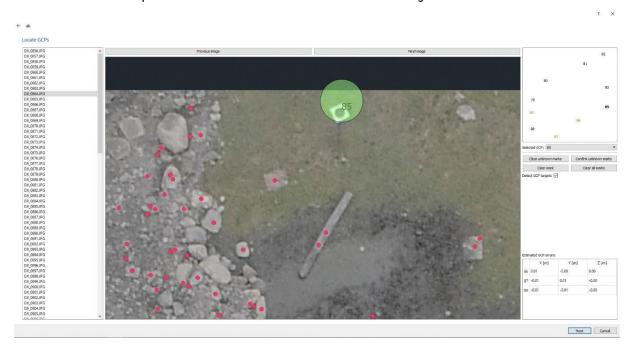
On the left of the pop-up window, **select image** with GCP. Scroll mouse to zoom in or out. For automatic orientation a minimum of 3 GCPs need to be manually marked. **Mark** GCP with a **right mouse click**. Marked position is coloured in orange and ascribed a "?" as its name is not defined.



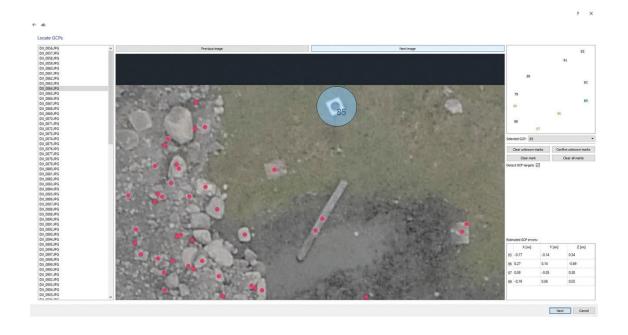
Continue by **selecting additional two** GCPs from other segments of your project area. When you select the third ground control point the automatic recognition for all other GCPs will start. Three marked GCPs remain orange coloured while automatically found GCPs are now coloured green and the names of all GCPs are identified. Click **Confirm unknown marks** beneath minimap.



Click on the first image from the list of images and check if circle is in top of gcp. The GCPs, that weren't selected in the process of automatic orientation are marked with green circle.



If the green circle is not positioned over the GCP, select the gcp on the minimap and click on it. Then click GCP's correct position on image. Color of its mark will turn blue. When you are satisfied, click Next image, and check gcps on all other images.

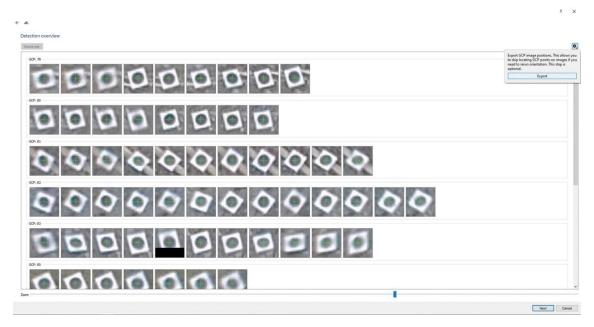


In the lower right corner appears the **residuals** of marked points. Residuals should be within 1m. Check if the automatic positions are calculated correctly - GCPs need to be coloured green. If not, correct them with manual selection. First, select the name of GCP on GCP map, then show the exact position of GCP map on an image. Use left mouse click. Click **next** to **continue with orientation**.

In the next step, we can see automatic recognition of ground control points (in case of 3Dsurvey targets). If the GCP is not recognised on a specific image, it is eliminated and coloured red. If you want to include this GCP into orientation, just double click the image and the red overlay will disappear. Several images can be marked or unmarked by ticking them in their upper left corner, where unticked square appears. Use Ctrl + a shortcut to select all target windows at once. You can also correct/realign the automatic measurement - put the mouse in the centre of the target and right mouse click for marking the center of GCP. Use mouse wheel or slide bar below to zoom in or out, which works for all target windows to realign easier.. Same approach can be used to correct the positions of GCPs that have been automatically detected but not measured perfectly because of the bad conditions during data acquisition.



If you do a lot of manual centering, back up your work by **exporting GCP image positions** of centred targets. Click **tooth wheel button** in the upper right corner and click **export**. In case if you calculate the same project again next time you don't need to select and correct the GCP targets once again but just import the saved file and go to the next step.



Click *next*, to observe orientation's accuracy.

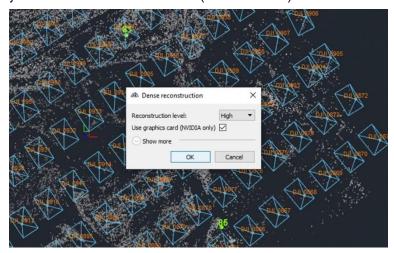
Orientation summary displays GCP errors – difference, between where we measured GCPs with Total Station/GPS, and where these points are in our photogrammetric model.. **Check GCPs accuracy** by **observing** their **residuals**. If residuals show high displacements of certain GCPs (over 4 cm), go and recheck them. Click **back** button on the upper left corner and repeat the marking process. Click **Finish** when satisfied.

Γ	×	Y	Z	Total
	0.002	0.001	-0.002	0.003
	-0.001	0.005	0.002	0.006
1	-0.004	-0.002	-0.003	0.005
2	0.000	0.001	0.002	0.002
	-0.000	-0.008	0,011	0.014
	0.007	-0.000	0.001	0.007
	0.009	0.006	0.031	0.033
7	-0.005	-0.001	0.001	0.005
18	-0.015	-0.021	-0.053	0.059
19	-0.002	-0.008	0.004	0.009

Save project. Click **Project -> Save AS**, and select the name of project. Its path is in the same file as imported images.

5. Reconstruction

When you are finished with *orientation wizard* the main window will appear. Next step is Reconstruction of dense point cloud. On image you can find the default values for Reconstruction step which offers you the most effective calculation (time VS results).



Click OK to start reconstruction.

Continuing each reconstruction parameter is described for more information. *Reconstruction level* – there are 4 levels of reconstruction:

- Low,
- Medium,
- High,
- Extreme.

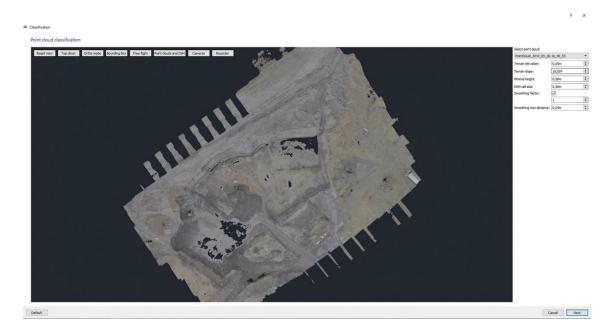
By default we use Medium, when main result will be ortho map, and High when we are interested in 3D data like volumes or 3D map.

5. CLASSIFICATION

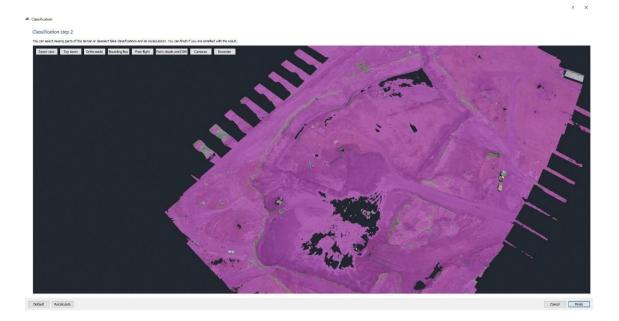
After pointcloud calculation finishes, it is important to first classify ground points.

Click Classification button to classify terrain points. In the pop up window, you can adjust:

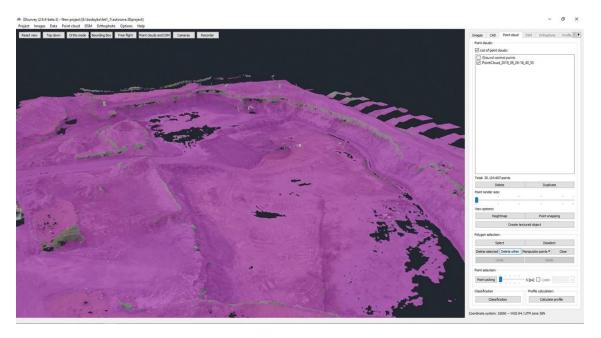
- terrain elevation -maximal sudden elevation change in terrain
- terrain slope -maximal angle between horizon and slope in degrees,
- minimal height minimal height of objects to be deleted,
- DSM cell size cell size of previously computed DSM,
- smoothing factor proportionate to smoothness of classified terrain
- smoothing maximum size maximal size of influential area.



Use mouses scroll and drag, to zoom to desired area. Left mouse click on desired area, to select it. Selected areas appear coloured. Not all terrain areas need to be selected. Click **next**.



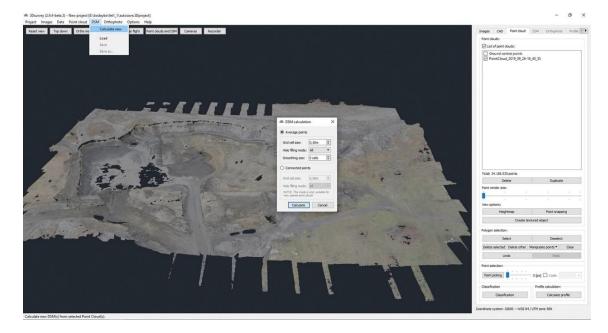
If all preferable areas are selected, click *Finish*. Otherwise, select the missing area and click *Next*. Click *Finish* to complete classification.



Click **Delete other**, to delete non-terrain point cloud points.

6. Digital surface model (DSM) manipulation

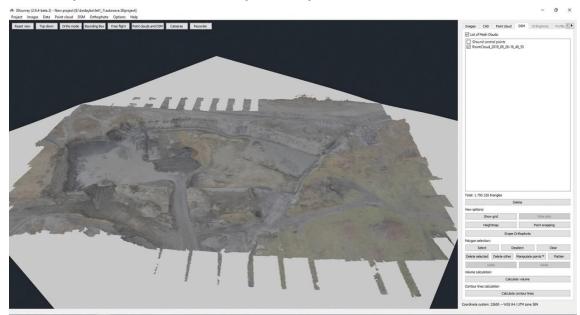
Select from dropdown list **DSM** -> **Calculate new** and set parameters.



For Orthophoto production the default parameters are:

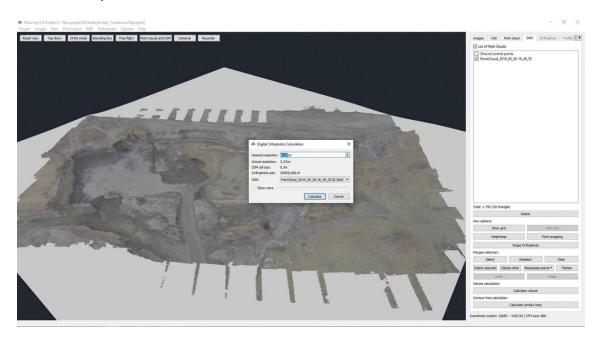
Grid cell size: 0.5mHole filling mode: AllSmoothing size: 0 cells

The lowest grid cell to be set is 20 cm and gives the highest detail.



7. DIGITAL ORTHOPHOTO

Select from dropdown list **DOF** -> **Calculate new**.



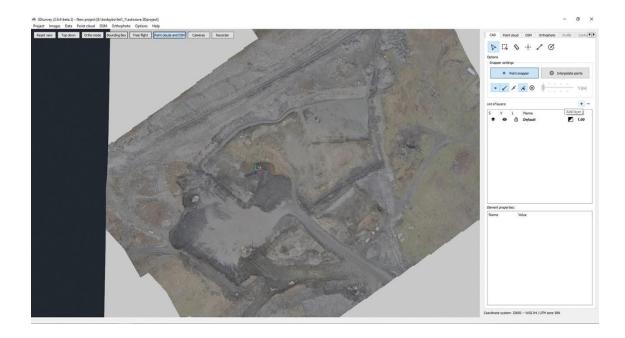
Set parameters in a *Digital Orthophoto Calculation* pop-up. First, set *Desired resolution*. Click *more* to check the *split DOF* box. Default *Tile maximum size* is set to 20.000, meaning DOF will be split if it exceeds 20.000 pixels. When set, click *Calculate*.

8. DRAW VOLUME BOUNDARY IN CAD

This section describes the definition of area for volume calculations.

8.1 Preparing layers

Click + to make new layer. To change name, double click it. Press enter to confirm. Double click on colour square, to change the colour. Change line weight by double clicking on number. Type new weight. Those layers that are visible, have a scheme in the second row, as opposed to non visible ones. At the time, only one layer can be selected, in the second row is visible, as oppose to all the others. Third row shows whether layer is **locked** or **unlocked**. To change any of layers attributes, click on unwanted scheme in desired row of layer.



8.2 Draw line

To draw set the desired layer and select **draw line** tool . Second, click on **snapper settings** to select type of snapping and **measurements display**. If you want to snap directly on point cloud point, select **point snapper**. This option supports also snapping on endpoints, midpoints and on or near existing lines.



Start drawing lines, using *left mouse click*. **If you misclicked use** *backspace to* **delete last point**. Abort drawing at any point with **escape** button. End drawing polygon of lines using *right mouse click*.



To close the polygon, make sure to have Point snpper selected, and snapping to endpoints enabled, and then just click on the first starting point of polygon. You can change **snapper settings** while drawing CAD objects.

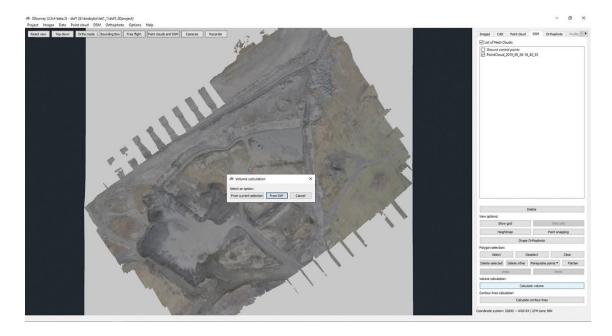
Click Data and select **Save CAD as...**, to save drawn polygon. Select preferable folder and type name. Data will be saved as dxf file.

9. VOLUME CALCULATION

9.1 Volume calculation from one surface

Calculate the volume of material for single measurement - appropriate for the calculation of dredged material.

To calculate the volume on the area drawn with CAD function, click *Calculate volume*. Click *From DXF*. An *Import DXF file* window appears. Select path and import desired *.dxf file.



Name of dxf file is appointed to calculated volume. Displayed results present values for both current volume selection and a total sum of all volumes, consisting of:

- Fill volume of needed mass to fill holes beneath mean surface.
- Cut volume of mass above mean surface
- Total sum of filled and cut volume
- Are 3D three-dimensional area of selected surface
- Area 2D horizontal area of selected surface

Select **Volume** from the **Working panel** to observe all calculated volumes. Areas of volume calculation are presented as cuts from **DSM**, each with its own title. If **Contour lines** are visible, their cuts are also presented. You can **select**, deselect and **remove selected** volumes.



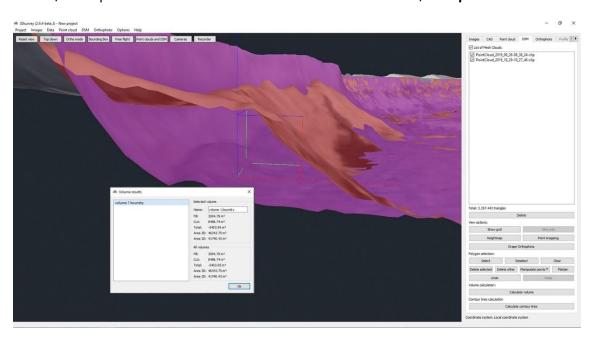
9.2 Volume calculation based on two consecutive measurements

Ideal for monitoring on construction site. Measure the volume difference between two consecutive measurements.

You need to have 2, or more point clouds. Click **DSM** -> Calculate new and set parameters as before.



Click ok, to compute DSMs. Select Calculate volume and further From DXF, then open dxf file.

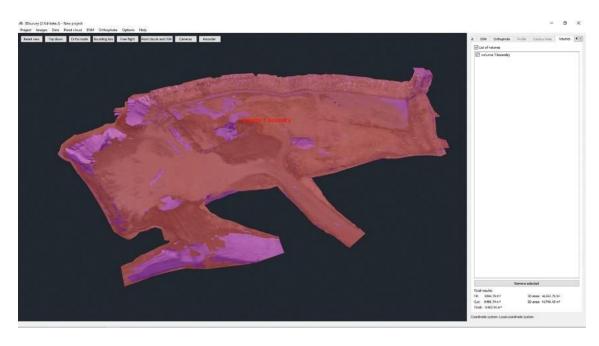


Name of dxf file is appointed to calculated volume. Selected areas of DSMs are coloured in different colours, so you can observe, height differences.

Presented results contain:

- Fill volume of added masses
- Cut volume of removed masses

- Total sum of filled and cut volume
- Area 3D three-dimensional area of selected surfaces
- Area 2D horizontal area of selected surfaces.



In the Working panel, go to Volume, to observe differences in volume.