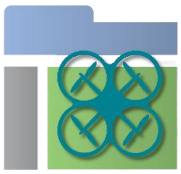
Step-by-Step guide for IMAGINE UAV workflow



Overview

This short guide will go through all steps of the UAV workflow that are needed to produce the final results. Those consist out of two raster datasets, the image mosaic and the digital surface model as well as out of a point cloud stored in the LAS format. The guide is based on UAV example data that is included in the installer. If you have installed the example data you find it in the folder: C:\Users\Public\GEOSYSTEMS\UAV\examples\gravel-pit

The UAV example datasets have generously been provided by GRID-IT (http://www.grid-it.at/).

Some remarks regarding the input data

- Use a digital camera with reasonably high resolution (5 Megapixel or more).
- Avoid ultra-wide angle and fish-eye lenses. The best choice is a lens with 50 mm focal length (35 mm film equivalent) but focal length might vary from 20 to 80 mm.
- Lenses with a fixed focal length are preferred. If zoom lenses are used - focal length should be set either to maximal or minimal value.
- Try to use the RAW data lossless converted to TIFF files. JPG compression adds unwanted noise to the images which might affect to accuracy.
- The ISO-value should be set to the lowest possible value. High ISO values will add additional noise to the images.
- Always use the original images. So do not crop or geometrically transform (e.g. resize or rotate) the images.
- Rough rule for image overlap: 60% of side overlap + 80% of forward overlap

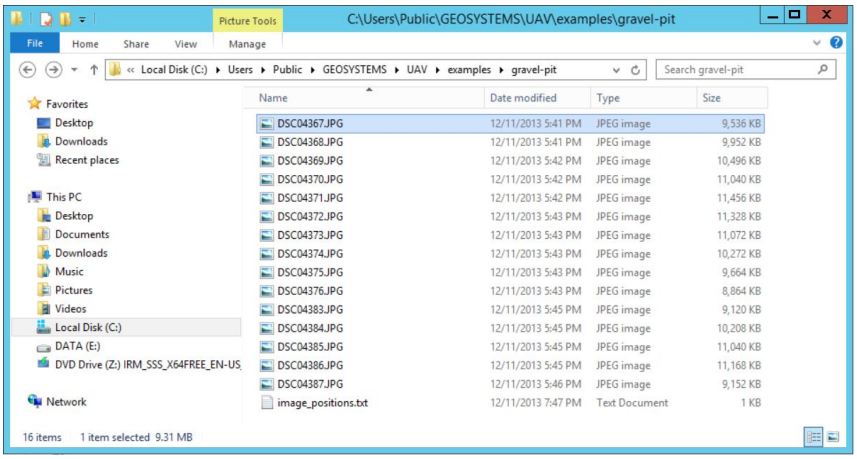
Step 1: Examination of the input data

The first step of the data processing is to examine your input datasets. This helps you choosing the right options for all processing settings as well as to get a rough idea about the processing time.

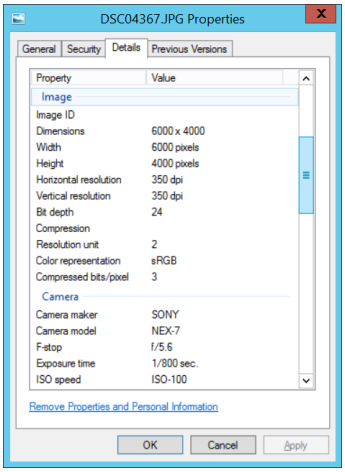
Some details that are important:

- File format (e.g. jpg or tif)
- Number of input datasets
- Number of columns and rows of each input file
- Type of the used image orientation (EXIF, external file, no orientation)
- Coordinate reference system of your reference data (center coordinates of the images)
- Geographic projection for your study area

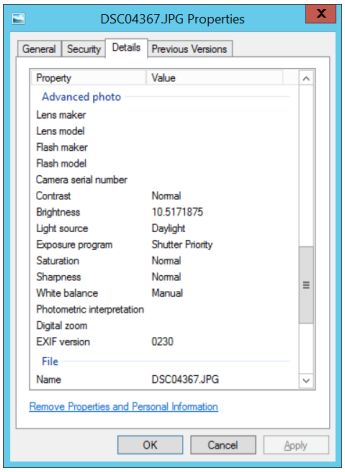
If we look at the folder that contains the example datasets we should see that it contains 15 jpg-images and one text file.



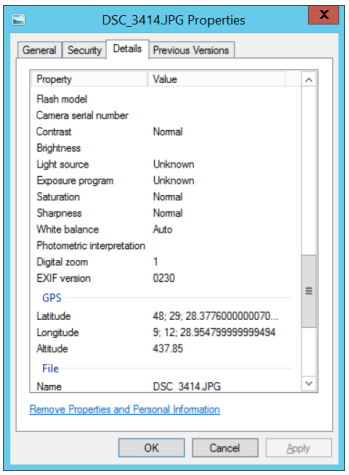
Please check the image properties by right clicking on an image. Select properties | details. The dimension of each image is 6000 by 4000 pixel.



Next you should look for GPS coordinates of the image center in the EXIF-information block. Depending on the source of your images you might now find a GPS section inside the image metadata. The provided images of the UAV example dataset also lack this kind of information. Please compare the following two screenshots. The first one shows one of the example images that does not contain GPS information:



The second one shows the image details for an image that does contain GPS-information:



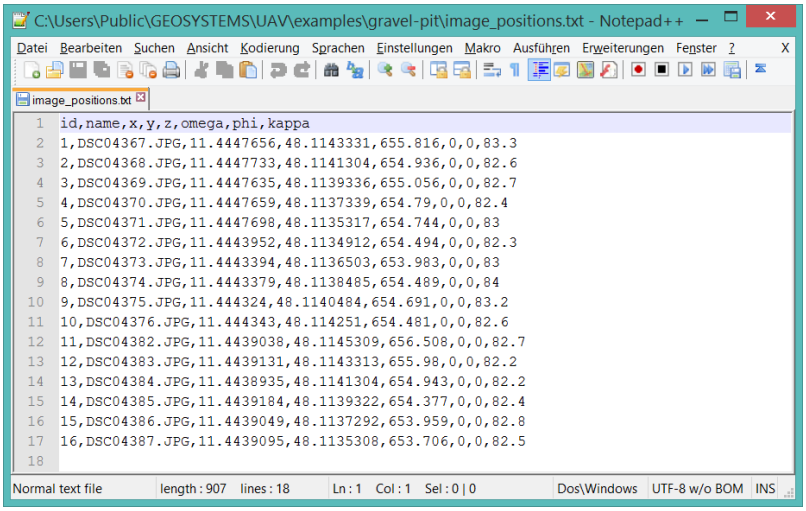
If we deal with images that do have GPS information processing is quite easy. The GPS information will be used directly if we select the option "From EXIF" in the setup project step. There is no need to reference any external files during data processing.

Since in our case we do not have geo-coordinates in the EXIF information we need to "import" the image position from an external text file included in the example directory.

Step 2: Define orientation format

This step can be skipped if you process datasets that have valid GPS information in the EXIF-header.

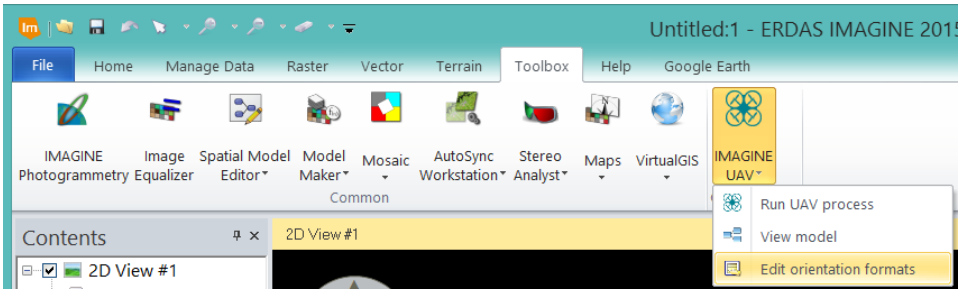
In order to be able to use the orientation information stored in a text file we need to define the input file structure. Let's have a look at the orientation file included in the example data. You are able to load C:\Users\Public\GEOSYSTEMS\UAV\examples\gravel-pit\image_positions.txt in any text editor:



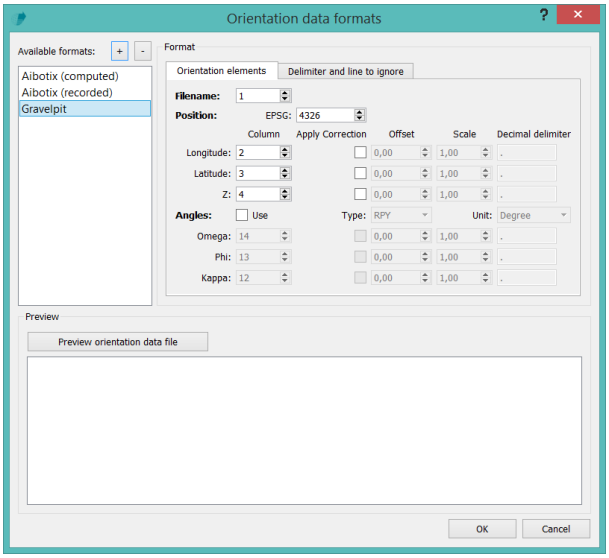
This plain text file contains comma separated values. The actual data values start from the second row. Here we are interested in the image filename (column 2), as well as in the image center coordinates X, Y and Z (column 3, 4 and 5). Since the algorithm used during image orientation is quite smart we are able to skip the camera rotation angles (omega, phi, kappa) for most of the cases. In order to project the final results correctly we need to know which coordinate reference system is used. In our case we have Lat/Lon values based on WGS84. So the EPSG code of the underlying coordinate reference system is 4326.

With all this information we are able to define the orientation format using the "Edit orientation formats" dialog.

Start the dialog by clicking in the Toolbox ribbon | Imagine UAV | on Edit orientation formats.

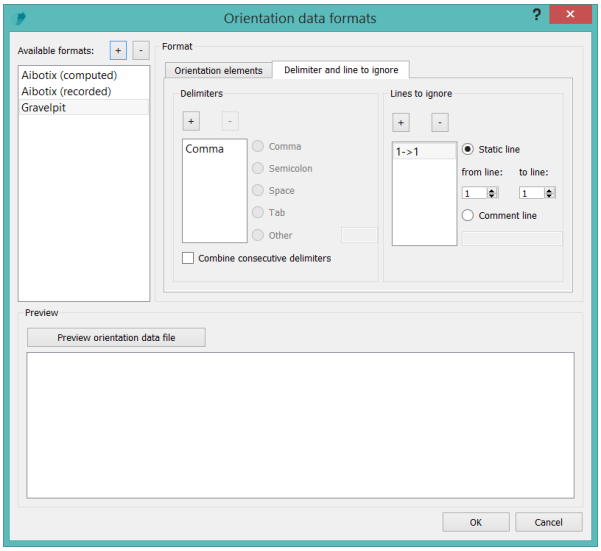


Create a new format defintion in the Orientation Format Editor by pressing the "+" button next to the Avialable formats entry. This will add a new row the the formats list. To rename the entry double klick on the new entry. Now set the name to Gravelpit.



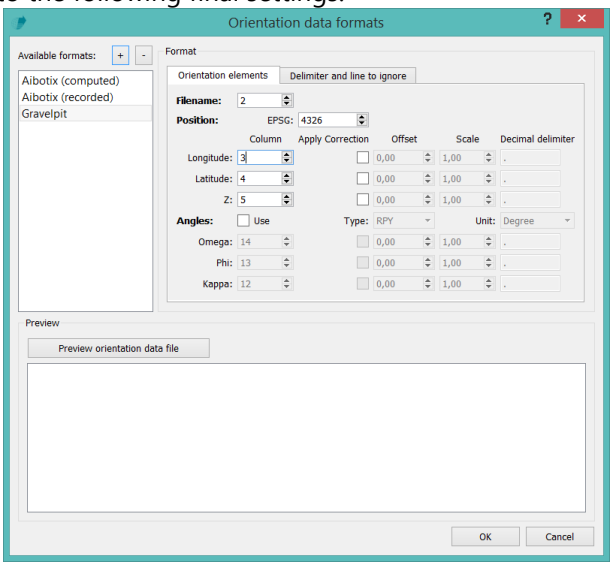
Next switch to the "Delimiter and ignore line" tab. Ensure that "Comma" is used as column delimiter. We also want to skip the first line containing the column descriptions. Add a new ignore line entry by clicking on the + button in the "lines to ignore" group. This will add a new skip entry starting from 1 and ending with line 1. This is exactly what we need. Entries can easily be modified. Just select the ignore option with a mouse click and modify the start and end options. Alternatively you may also set a comment character(s). All lines starting with this character(s) will be skipped. You may add any number of skip options.

For your example the settings in "Delimiter and ignore line" tab should look as follows:



The last step is to assign the column numbers to the needed processing values and specify the coordinate reference system of the input values.

The image filename is stored in column 2 of the input data. The image center coordinates X, Y and Z can be found in column 3, 4 and 5. Since we will not use the rotation angles we keep this option disabled. We also know that the EPSG-code of the coordinate reference system is 4326. This will lead to the following final settings:



Press the OK button to save all modified settings.

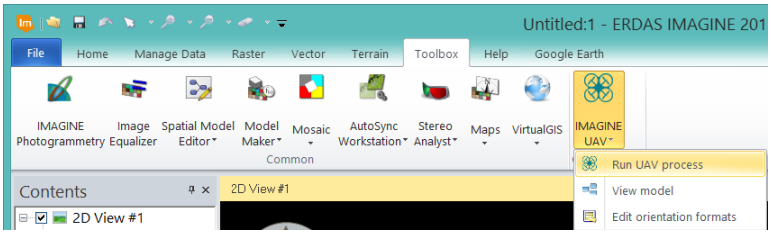
The additional options allow you to:

- Define a constant offset for all input values (e.g. when coordinate have been cut off)
- Define a scale factor for each input value (e.g. when the input values are stored in cm but you need to use m for the process)
- Override the decimal delimiter (e.g. certain countries are using "," as default decimal delimiter)

Now we are ready to start processing the UAV example dataset.

Step 3: Start processing

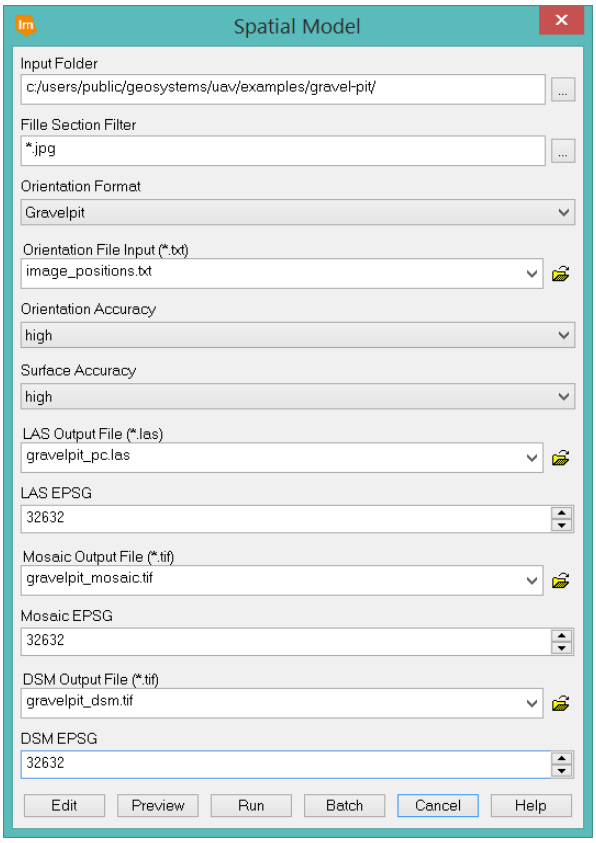
Start the run model dialog by clicking in the Toolbox ribbon | Imagine UAV | on Run UAV process.



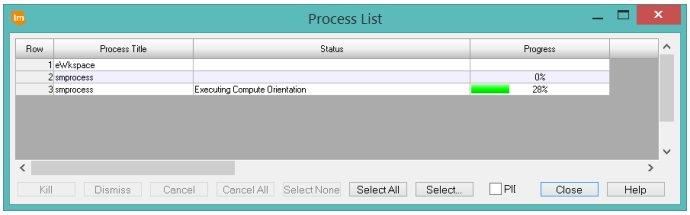
Specify the following processing options in the upcoming dialog:

- Input Folder: c:/users/public/geosystems/uav/examples/gravel-pit/
- File Selection Filter: *.jpg (all jpg files in the Input Folder will be selected)
- Orientation Format: Gravelpit (which we have created in step 2)
- Orientation File Input: c:/users/public/geosystems/uav/examples/gravel-pit/image_positions.txt
- Orientation Accuracy: high (very good quality for the image orientation)
- Surface Accuracy: high (very detailed point cloud and thus surface; will take much more time to compute compared to medium; select low for a first try when dealing with an unknown dataset in order to reduce the computation time to a minimum)
- Set the output file for the point cloud in LAS-format: gravelpit_pc.las (in any directory with write access – e.g. create a new directory c:/users/public/geosystems/uav/examples/gravel-pit/results)
- Set LAS projection to 32632 (UTM zone 32 north/WGS84)
- Set output file for the mosaic in TIF-format: gravelpit_pc.tif (in any directory with write access – e.g. create a new directory c:/users/public/geosystems/uav/examples/gravel-pit/results)
- Set the mosaic projection to 32632 (UTM zone 32 north/WGS84)
- Set output file for the DSM in TIF-format: gravelpit_dsm.tif (in any directory with write access – e.g. create a new directory c:/users/public/geosystems/uav/examples/gravel-pit/results)
- Set the DSM projection to 32632 (UTM zone 32 north/WGS84)

The settings should like as follows. Please double check before you start the process by clicking on the Run-button.

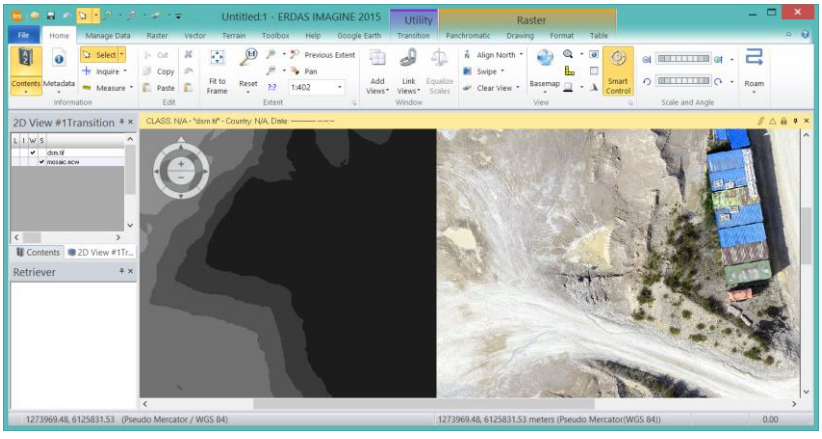


Depending on the power/speed of your PC the processing will take quite a while (20 - 30 minutes) to finish. Check the process status in the IMAGINE process list. Each operator should report the current progress.

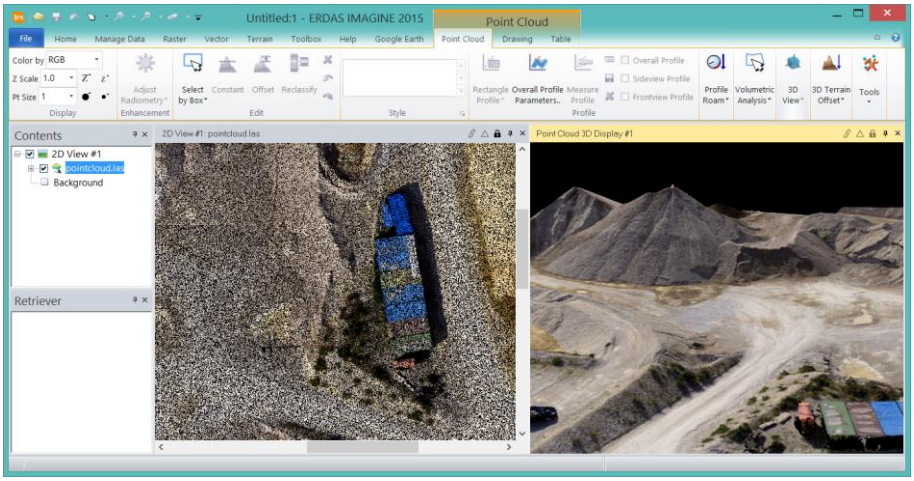


Step 4: Display the results

After the process has finished you are able to display the three output datasets in the IMAGINE viewer. Just open the mosaic and/or DSM as raster files in the IMAGINE viewer:

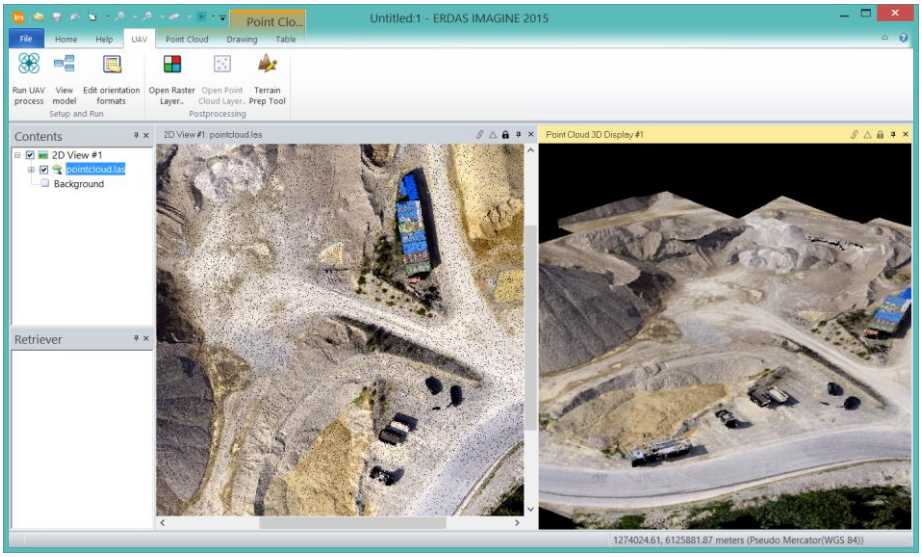


The computed point cloud in the LAS format can also be directly opened with the IMAGINE viewer via “Open Point Cloud Layer”. You will see that the points are rgb-encoded, this means that every point has stored the RGB-value of the underlying input pixel. You are also able to display the point cloud in 3d:



Hint: Use the UAV-layout

If your main focus is processing UAV data you may think about using the provided UAV layout instead of the default interface of ERDAS IMAGINE. The UAV layout contains only the most needed functions as seen in the screenshot below:



Using the UAV operators

If you have access to an ERDAS IMAGINE Professional license you are also able to use the UAV operators within the Spatial Modeler.

We are providing a pre-cooked UAV model for you convenience that can be accessed by clicking on “View model” button in the UAV main menu. This will open up the base model within the Spatial Modeler Editor.

In order to process the example dataset change the following settings:

- Input ports of the "Create project" operator:
  - Image Directory: c:/users/public/geosystems/uav/examples/gravel-pit/
  - Orientation Format: Gravelpit
  - Orientation File: c:/users/public/geosystems/uav/examples/gravel-pit/image-positions.txt
- Input ports of the "Export LAS" operator:
  - LASName: output file for the point cloud in LAS-format: gravelpit_pc.las
  - EPSG: 32632 (UTM zone 32 north/WGS84)
- Input ports of the "Export Mosaic" operator:
  - MosaicName: output file for the image mosaic: gravelpit_mosaic.tif
  - EPSG: 32632 (UTM zone 32 north/WGS84)
- Input ports of the "Export DEM" operator:
  - DEMName: output file for the DSM: gravelpit_dsm.tif
  - EPSG: 32632 (UTM zone 32 north/WGS84)

Ensure that the final model should looks like as follows before you start the process.