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### SECTION 1

# GEOSYSTEMS

#### **UAV Workflow**

The **GEOSYSTEMS UAV** Workflow supports the computation of digital ortho mosaics, digital elevation models and point clouds from overlapping image data captured with small and medium sized frame cameras from within the **ERDAS IMAGINE Spatial Modeler**.

#### **ERDAS IMAGINE UAV Feature Overview**

The **ERDAS IMAGINE UAV** operators for the **ERDAS IMAGINE Spatial Modeler** enable you to create an ortho-mosaic, a photogrammetric point cloud, and a digital surface model (**DSM**) out of UAV still images. Both the image alignment as well as the creation of the outputs are fully automated. You can project the results to a coordinate system specified by an **EPSG**.

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### **ERDAS IMAGINE UAV Feature**

#### Processing Workflow Concept

There are four main processing steps which you can identify by opening up the underlying spatial model of the UAV workflow:

- 1. The first step creates a new UAV project. You need to specify the image data and the orientation information (if available).
- 2. The next step computes the image orientation. During this process the system searches for common points in the input images, identifies the position of the camera for each picture, and refines camera calibration parameters. The results are a sparse point cloud and a set of camera positions. You need to define the level of accuracy as well as the preselection parameter for the image matching.
- 3. The **Compute Surface** operator creates a 3D polygonal mesh. Based on the estimated camera positions and image data, a dense point cloud is generated first. This is then used as input for the





creation of 3D polygonal mesh representing the object surface described by the point cloud. For this operator you need to set several parameters that are influencing the quality of the point cloud and of the 3D surface as well as the computation time.

- 4. The final step produces the final output dataset or datasets. You can also reuse all results created in the model to create a complex workflow like image classification based on the UAV datasets.
  - a. **Export Mosaic** allows you to export the computed surface as digital ortho mosaic. The export supports the image file formats **ECW**, **JPEG2000**, **IMG** and **TIF**.
  - b. **Export DEM** allows you to export the computed surface as digital elevation model. The export supports the image file formats **IMG** and **TIF**.
  - c. Export LAS allows you to export the computed point cloud as LAS file with RGB encoding.

#### IMAGINE UAV Menu

The IMAGINE UAV menu is located in the Toolbox tab.



The IMAGINE UAV menu contains the following functions:







#### **Run UAV Process**

Click **Run UAV process** to execute the default UAV Model, however you can also specify the needed input parameters to run a customized model. Hover the mouse over an item to open bubble help for each parameter. You can skip creating an output product if you leave the filename selection for this product empty. For more information, see *ERDAS IMAGINE UAV Workflow* (see "*Step-by-Step guide for the IMAGINE UAV Workflow*" on page 24).

	Spatial Model	×
Input Folder		
c:/users/public/geosystems/u	av/examples/	
File Selection Filter		
*.jpg		
Orientation Format		
Gravelpit		~
Orientation File Input (*.txt)		_
image_positions.txt		× 🖗
Time Offset for GPS-Track		
+00:00:00		
Orientation Accuracy		
high		~
Surface Accuracy		
high		~
Output EPSG		
3857		-
LAS Output File (*.las)		
gravelpit-point-cloud.las		🖉
Mosaic Output File (*.img)		
gravelpit-mosaic.img		× 👼
DSM Output File (*.img)		
gravelpit-dsm.img		× 👼
Edit Preview	Run Batch Cancel	Help





#### View model

Click **View model** to open the default UAV Model in the Spatial Modeler Editor, where you can modify or extend the UAV model. Spatial Modeler Editor requires an ERDAS IMAGINE Professional level license.







#### **Edit Orientation Formats**

Click **Edit orientation formats** to open the Orientation data formats dialog to extend the list of supported orientation data formats. See *ERDAS IMAGINE UAV Workflow* (see "*Step-by-Step guide for the IMAGINE UAV Workflow*" on page 24) for an example.

Gravel-Pit         Position:       EPSG:         4326         Column       Apply Correction         Offset       Scale         Decimal delimite         Longitude:       3         Q       0,00         Latitude:       4         Q       0,00         Q       1,00         Phi:       13         Q       0,00         Long       1,00         Long       1,00         Long       1,00         Long       1,00         Long       1,00         Long       1,00      <	Aibotix (computed) Aibotix (recorded)	Orientation el	ement 2	s D	elimiter and line to	o ignore					
Column       Apply Correction       Offset       Scale       Decimal delimite         Longitude:       3       0,00       1,00       .         Latitude:       4       0,00       1,00       .         Z:       5       0,00       1,00       .         Angles:       Use       Type:       RPY       Unit:       Degree         Omega:       14       0,00       1,00       .       .         Phi:       13       0,00       1,00       .       .         Preview			2		4326						
Latitude:       4       0,00       1,00       .         Z:       5       0,00       1,00       .         Angles:       Use       Type:       RPY       Unit:       Degree         Omega:       14       0,00       1,00       .         Phi:       13       0,00       1,00       .         Kappa:       12       0,00       1,00       .	ClosterFFB		Co		L Bong	Offse	et -	Scale		Decimal delimite	r
Z: 5 0 0,00 0 1,00 0 . Angles: Use Type: RPY V Unit: Degree V Omega: 14 0 0,00 0 1,00 0 . Phi: 13 0 0,00 0 1,00 0 . Kappa: 12 0 0,00 0 1,00 0 . Preview		Longitude:	3	٥		0,00	\$	1,00	٥		
Angles:         Use         Type:         RPY         Unit:         Degree           Omega:         14         0,00         1,00         .           Phi:         13         0,00         1,00         .           Kappa:         12         0,00         1,00         .		Latitude:	4	٥		0,00	\$	1,00	٥		
Omega:         14         0,00         1,00         .           Phi:         13         0,00         1,00         .           Kappa:         12         0,00         1,00         .		Z:	5	٥		0,00	٥	1,00	٥		
Phi: 13 0,00 0 1,00 0 . Kappa: 12 0 0,00 0 1,00 0 .		Angles:	U:	se	Type:	RPY	v	, U	Jnit:	Degree *	
Kappa:         12         0,00         1,00         .           Preview         .         .         .         .         .		Omega:	14			0,00	\$	1,00	¢		
Yeview		Phi:	13			0,00	\$	1,00			
		Kappa:	12	\$		0,00	\$	1,00	٥		
Preview orientation data file		a file									

#### IMAGINE UAV Layout

A new GEOSYSTEMS UAV Workflow Layout is added during the installation of the IMAGINE UAV package. This contains the most important functions needed for the UAV data processing.





∾ 📀 Help Home UAV 8 2 Run UAV View Edit orientation Open Raster Open Point Terrain Layer.. Cloud Layer.. Prep Tool process model formats Setup and Run Postprocessing *S* △ A ₽ × Ψ× 2D View #2 Contents 💿 🍡 🖄 🖉 n 🛈 👼 🕂 🖃 🗹 📰 2D View #2 B Background Retriever Ψ× 180.00 (CCW

To apply this layout, click File > Layout and select the GEOSYSTEMS UAV Workflow layout.



Create Project



### **Create Project**

#### Category: GEOSYSTEMS UAV



#### Description

Creates a new UAV project based on the selected image data. Image files are taken from the provided **directory**, considering the entered **wildcard** pattern. Images can be processed with or without available orientation information. If orientation data are available, they can be taken directly from the image data itself (**EXIF** information) or read from any **table** like text file containing a column with the image file names. The list of supported text file formats for the orientation data can be dynamically extended.

Double click on the port **OrientationFormat** to open a dialog with the available orientation sources or formats. Select **No initial Orientation** to process image data without any orientation information. Select **From Exif** to take the orientation information directly from the image data. In this case, the presence of the **Exif** data is validated for each selected image file.

**From GPS track** allows the direct usage of an existing GPS-track information stored as GPX-file. The GPX-file needs to be provided on the port **OrientationDataFile.** The image creation timestamp is used to find/interpolate the according GPS position within the GPX-file. If there is a time difference between GPS and camera, an offset can be specified on the port **TimeCorrection** that is hidden by default. The positions of the GPX-tracks are always based on the UTC time zone therefore the time correction must specify the offset of the image recording time with respect to UTC. If for example an image was taken at 12:45:12 local time (German timezone; daylight saving time) we need to consider a time offset of +2 hours





(UTC + 1 with +1 for daylight saving time). If there is a misalignment between camera time and GPS time - e.g. GPS receiver shows 10:35:10 and the camera shows 12:45:12 the time correction will be +2:10:02.

Any other format in the list refers to custom formats of orientation data. If one of them is selected, the actual text file with the orientation data has to be provided using port **OrientationDataFile**.

🌒 Se	lect Option ?	×
Orientation Format		
OrientationFormat	From Exif   No initial Orientation	
ОК	From Exif From GPS track Aibotix (computed)	
	Aibotix (recorded) Gravelpit Zankenhausen	

To define a new format for your text file based orientation data, click button.

#### **Orientation Formats**

Value	Description
No Initial Orientation	Allows to process image data for which no orientation data are available.
From Exif	Takes the orientation data directly from the image files by extracting the <b>Exif</b> information. The presence of the <b>Exif</b> data is validated for each selected image file.
From GPS track	Uses a GPX-file to interpolate image positions based on image recording time.







<pre><custom formats=""> Any of customer defined format of text base orientation data files.</custom></pre>	∋d
---	----

To learn how to define a custom orientation data format, see *ERDAS IMAGINE UAV Workflow* (see "*Step-by-Step guide for the IMAGINE UAV Workflow*" on page 24).

#### Image pattern

Character	Description
?	Matches any single character, identical to full regular expressions. For example, <i>DSC_123?.jpg</i> selects files such as <i>DSC_1231.jpg</i> , <i>DSC_1232.jpg</i> or <i>DSC_1233.jpg</i> .
*	Matches zero or more of any characters, identical to full regular expressions. For example, <i>DSC_123*.jpg</i> selects files such as <i>DSC_123.jpg</i> , <i>DSC_1232.jpg</i> or <i>DSC_12345.jpg</i> .
[]	Sets of characters can be represented in square brackets, similar to full regular expressions. For example, DSC_123[3-5].jpg selects only the files DSC_1233.jpg, DSC_1234.jpg or DSC_1235.jpg.

#### Connections

Name	Objects Supported	Description	Require d
ImageDirectory	Directory	Directory containing the imagery to be processed.	<b>~</b>
ImagePattern	String	Pattern to use to select images inside the provided <b>ImageDirectory.</b> The entered pattern is interpreted as <b>wildcard</b> matching pattern to select files. The default value is <i>*.jpg</i> , which selects all <b>JPG</b> -images.	~





OrientationFormat	String/Enumeration	Specifies the source/format to take orientation data from. If not specified, <b>FromExif</b> is used. The list of supported orientation data formats can be extended dynamically.	
OrientationDataFile	File	Text file with orientation data or GPX file when using <b>From</b> <b>GPS track</b> . This file is only required when selecting a custom orientation data format or using <b>From GPS track</b> .	
TimeCorrection	TimeCorrectionDat a (String)	Time offset of image recording time with respect to UTC time (which are recorded in the GPX file). The format is as follows: <sign><hh>:<mm>:<ss> - for example: -00:02:23 or +02:00:00</ss></mm></hh></sign>	
UAVProject	UAVProject	The created UAV project that can only be used as input for the subsequent UAV operator <b>Compute Orientation</b> . After a successful execution, the file <i>projectFile_initial.psz</i> is created in the <b>ImageDirectory.</b>	

#### Syntax

```
CreateProject ( <ImageDirectory> , <ImagePattern>[, <OrientationFormat>][,
<OrientationDataFile>] [,TimeCorrection] )
```

Load Project

Category: GEOSYSTEMS UAV







#### Description

Loads an existing UAV project from disk. This operator is only provided for convenience to allow loading an already processed UAV project. You can use it to reload a specific processing step and then continue that step without re-processing. The project files to load are located in the directory containing the actual image data. The following processing steps can be reloaded.

<b>Project Files on Disk</b>
------------------------------

Project File Name	Description
projectFile_initial.psz	Result of the <b>Create Project Operator</b> . When selecting this file, you can skip the <b>Create</b> <b>Project</b> step. You can use the loaded project directly as input for the <b>Compute Orientation</b> <b>Operator</b> .
projectFile_ori.psz	Result of the <b>Compute Orientation</b> <b>Operator.</b> When selecting this file, you can skip the <b>Compute Orientation</b> step. You can use the loaded project directly as input for the <b>Compute Surface Operator</b> .
projectFile.psz	Result of the <b>Compute Surface Operator</b> . When selecting this file, you can skip the <b>Compute Surface</b> step. You can use the loaded project directly as input for export operators <b>Export Mosaic Operator</b> , <b>Export</b> <b>LAS Operator</b> and <b>Export DEM Operator</b> .

#### Connections

Name	Objects Supported	Description	Require d
ProjectName	File	File name of the project to be loaded from disk.	<





UAVProject	UAVProject	Loaded UAV project which can be used as input for the according subsequent UAV operators (see table above). The process will fail if used as input for any other UAV operator as stated in the table above.	
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#### Syntax

LoadProject ( <ProjectName> )

### **Compute Orientation**

#### Category: GEOSYSTEMS UAV



#### Description

Computes the orientation of all images referenced in the **UAVProjectIn**. The computed orientation can be relative when no absolute orientation information was provided during project creation. Otherwise it is an absolute orientation. The parameter **Accuracy** influences the quality of the computed orientation. A higher value results in a more precise determination of the camera positions, whereas a lower value produces a less precise result in a shorter period of time. The parameter **Preselection** determines how many overlapping image pairs are found, which has a significant influence on the computation time, especially for large sets of image data.





#### Compute Orientation

#### Accuracy Parameter

🏓 Selec	ct Option ? ×
Orientation Accuracy	
Accuracy	medium 👻
ОК	Cancer

Value	Description
Low	Creates less precise camera positions but computation produces results in a much shorter time.
Medium	Presents a balance between precise camera positions and computation time.
High	Creates very precise camera positions but takes longer time for computation. If nothing is selected, this value is default.

#### **Preselection Parameter**

<b>#</b>	Select	Option	?	×
Image Preselection				
Preselection	ОК	generic disabled generic ground control Cancer		





Value	Description
Disable	No preselection is executed. All possible image pair combinations are computed, resulting in a longer computation time.
Generic	The preselection is based on image correlation in lower resolution images. For large image datasets this can still consume a significant amount of time as all combinations of image pairs are being evaluated.
Ground Control	If ground control information (initial camera orientation data) were specified during project creation, this information is used to reduce the number of image pairs that are evaluated, thereby improving the computation time.

Name	Objects Supported	Description	Required
UAVProjectIn	UAVProject	An UAV Project that has been created using the Create Project Operator or loaded from disk using the <b>Load Project Operator</b> .	*
Accuracy	String/Enumeration	Parameter influencing the accuracy of the computed orientation. Must be one of the values from the table above. If not provided, the default value <b>high</b> is used.	
Preselection	String/Enumeration	Parameter determining how overlapping image pairs are selected. Must be one of the values from the table above. If not provided, the default value <b>generic</b> is used.	





UAVProjectOut		The <b>UAV</b> project which can only be used as input for the subsequent <b>UAV</b> operator <b>Compute Surface.</b> After a successful execution, the file <i>projectFile_ori.psz</i> is created in the <b>ImageDirectory.</b>	
---------------	--	--	--

#### Syntax

ComputeOrientation ( <UAVProjectIn> [, <Accuracy> ][, <Preselection>])

### **Compute Surface**

#### Category: GEOSYSTEMS UAV



#### Description

Computes the actual point cloud and surface based on the orientation, produced using the **Compute Orientation Operator**. There are several parameters influencing quality and computation time. The parameter **Quality** influences the level of detail of the reconstruction. A higher value results in a more detailed reconstruction but can take a very long time to produce results. A lower value produces a more coarse reconstruction but computation time is much shorter. The parameter **Filter** determines how the determined point cloud is being filtered. The point cloud can be filtered aggressively to yield a smooth surface or not at all to keep all computed points. Use the parameter **Mode** to select the type of surface to be computed. In most cases this parameter can remain at default value. The parameter **FaceCount** determines how many polygons are used when meshing the computed point cloud.





### Quality Parameter

<b>9</b>	Select	Option	?	×
Surface Quality				
Quality	ОК	medium lowest low medium high ultra		

Value	Description
Lowest, Low, Medium	Creates less detailed point clouds but computation time is relatively short. Should be used only to get a quick impression of the surface.
High	Creates a detailed reconstruction of the surface. If nothing gets selected this value is default.
Ultra	Creates a very detailed reconstruction of the surface but increases the chance of outliers. Additionally the computation time is significantly longer than using <b>high</b> .





#### Filter Parameter

۶ (	elect Option	? ×
• Surface Filtering		
Filter	aggressive mild moderate	•
Ok	aggressive	

Value	Description
Mild, Moderate	Filters the point cloud to remove outliers but keeps detailed feature.
Aggressive	Filters the point cloud aggressively to yield a smoother surface, removing possible outliers and very small features. If nothing gets selected this value is default.
Disabled	Does not filter the point cloud at all; therefore keeps all computed points.





#### Mode Parameter

Select Option							
Surface Mode							
Mode	OK	height field arbitrary height field Cancel					

Value	Description
Arbitrary	Can be used to model any type of surface. Typically this value only has to be selected if objects like buildings or statues are being reconstructed.
Height Field	Used to model planar surfaces and sufficient for most of the <b>UAV</b> workflows. If nothing is selected this value is default.

#### Face Count Parameter

🍠 Select	Option ? ×
Surface Face count	
FaceCount	medium  low medium high Cancer





Value	Description
Low	Creates a smaller amount of polygons or faces but computation is shorter.
Medium	Presents a balance between low and high. If nothing is selected, this value is default.
High	Creates a large number of polygons or faces to mesh the point cloud but takes longer for computation.

Name	Objects Supported	Description	Require d
UAVProject	UAVProject	An <b>UAV</b> Project that has been created using the <b>Compute Orientation Operator</b> or loaded from disk using the <b>Load Project Operator</b> .	\$
Quality	String/Enumeration	Parameter influencing the quality or details of the reconstruction of the surface. Must be one of the values from the table above. If not provided, the default value <b>high</b> is used.	
Filter	String/Enumeration	Parameter determining how to filter the computed point cloud to remove possible outliers and to create a smooth surface. Must be one of the values from the table above. If not provided, the default value <b>aggressive</b> is used.	
Mode	String/Enumeration	Parameter selecting the type of surface to reconstruct. Must be one of the values from the table above. If not provided, the default value <b>aggressive</b> is used.	





FaceCount	String/Enumeration	Parameter determining the number of polygons/faces to be used when meshing the surface. Must be one of the values from the table above. If not provided, the default value <b>aggressive</b> is used.	
UAVProjectOu t	UAVProject	The <b>UAV</b> project that can only be used as input for the subsequent export operators <b>Export Mosaic</b> <b>Operator, Export LAS Operator</b> and <b>Export DEM</b> <b>Operator</b> . After a successful execution, the file <i>projectFile.psz</i> is created in the <b>ImageDirectory</b> .	

#### Syntax

```
ComputeSurface ( <UAVProjectIn> [, <Quality> ][, <Filter>] [, <Mode> ] [,
<FaceCount> ])
```

### Export LAS

#### Category: GEOSYSTEMS UAV



#### Description

Exports the computed point cloud as **LAS** file with RGB encoding. If the point cloud was reconstructed from image data with known camera positions and the parameter **EPSG** is provided, the **LAS** point cloud is re-projected to the specified projection system. Otherwise local planar coordinates are used.

See HexGeoWiki EPSG Coordinate Systems (https://wiki.hexagongeospatial.com//index.php?title=EPSG\_Coordinate\_Systems).





Name	Objects Supported	Description	Required
UAVProjectIn	UAVProject	An UAV Project that has been created using the Compute Surface Operator or loaded from disk using the Load Project Operator.	*
LASName	File	File name of the <b>LAS</b> file to be created.	✓
EPSG	Integer	If the point cloud was reconstructed from image data with known camera positions, use this parameter to assign the projection and to re-project the result into the desired projection system.	
LASFile	File	Created LAS file on disk.	

#### Syntax

```
ExportLAS ( <UAVProjectIn> , <LASName> [, <EPSG>] )
```

### Export DEM

#### Category: GEOSYSTEMS UAV



#### Description

Exports the computed surface as digital elevation model. The export supports the image file formats **IMG**, and **TIF**. The created file is using a bit depth of 32, producing **float** data type. If the surface was reconstructed from image data with known camera positions and the parameter **EPSG** is provided, the **DEM** file is re-projected to the specified projection system. Otherwise local planar coordinates are used.

See HexGeoWiki EPSG Coordinate Systems (https://wiki.hexagongeospatial.com//index.php?title=EPSG\_Coordinate\_Systems).





Name	Objects Supported	Description	Require d
UAVProjectIn	UAVProject	An UAV Project that has been created using the <b>Compute Surface</b> <b>Operator</b> or loaded from disk using the <b>Load Project Operator</b> .	<
DEMName	File	File name of the <b>DEM</b> file to be created. Supports the export of the formats <b>IMG</b> and <b>TIF</b> .	~
EPSG	Integer	If the surface was reconstructed from image data with known camera positions, use this parameter to assign the projection and to re-project the result into the desired projection system.	
DEMFile	File	Created <b>DEM</b> file on disk.	

#### Syntax

```
ExportDEM ( <UAVProjectIn> , <DEMName> [, <EPSG>] )
```

### **Export Mosaic**

#### Category: GEOSYSTEMS UAV



#### Description

Exports the computed surface as digital ortho mosaic. The export supports the image file formats **ECW**, **JPEG2000**, **IMG** and **TIF**. If the surface was reconstructed from image data with known camera positions and the parameter **EPSG** is provided, the mosaic file is re-projected to the specified projection system. Otherwise local planar coordinates are used.

See HexGeoWiki EPSG Coordinate Systems (https://wiki.hexagongeospatial.com//index.php?title=EPSG\_Coordinate\_Systems).





Name	<b>Objects Supported</b>	Description	Required
UAVProjectIn	UAVProject	An UAV Project that has been created using the <b>Compute Surface Operator</b> or loaded from disk using the <b>Load Project Operator</b> .	~
MosaicName	File	File name of the mosaic file to be created. Supports the export of the formats <b>ECW</b> , <b>IMG</b> , <b>TIF</b> and <b>JPEG2000</b> .	~
EPSG	Integer	If the surface was reconstructed from image data with known camera positions, use this parameter to assign the projection and to re-project the result into the desired projection system.	
MosaicFile	File	Created ortho mosaic file on disk.	

#### Syntax

ExportMosaic ( <UAVProjectIn> , <MosaicName> [, <EPSG>] )

### Step-by-Step guide for the IMAGINE UAV Workflow

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

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

Notes 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 you use a zoom lenses 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 the accuracy.
- The ISO-value should be set to the lowest possible value. High ISO values add additional noise to the images.
- Always use the original images. Do not crop or geometrically transform (for example, resize or rotate) the images.
- Rough rule for image overlap: 60% of side overlap + 80% of forward overlap

#### Examine the Input Data Processing Step

The first processing step is to examine your input datasets to help you choose the right options for all processing settings as well as to get a rough idea about the processing time.

Notable details:

- File format (for example, 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





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Favorites	Name	Date modified	Туре	Size	
Desktop	SC04367.JPG	12/11/2013 5:41 PM	JPEG image	9,536 KB	
🐌 Downloads	SC04368JPG	12/11/2013 5:41 PM	JPEG image	9,952 KB	
Secent places	SC04369.JPG	12/11/2013 5:42 PM	JPEG image	10,496 KB	
	SC04370.JPG	12/11/2013 5:42 PM	JPEG image	11,040 KB	
This PC	SC04371JPG	12/11/2013 5:42 PM	JPEG image	11,456 KB	
📔 Desktop	SC04372.JPG	12/11/2013 5:43 PM	JPEG image	11,328 KB	
Documents	SC04373.JPG	12/11/2013 5:43 PM	JPEG image	11,072 KB	
😹 Downloads	SC04374JPG	12/11/2013 5:43 PM	JPEG image	10,272 KB	
Music	SC04375JPG	12/11/2013 5:43 PM	JPEG image	9,664 KB	
JE Pictures	SC04376JPG	12/11/2013 5:43 PM	JPEG image	8,864 KB	
📓 Videos	SC04383JPG	12/11/2013 5:45 PM	JPEG image	9,120 KB	
Local Disk (C:)	SC04384JPG	12/11/2013 5:45 PM	JPEG image	10,208 KB	
🕞 DATA (E:)	SC04385JPG	12/11/2013 5:45 PM	JPEG image	11,040 KB	
DVD Drive (Z:) IRM_SSS_X64FREE_EN-US	SC04386.JPG	12/11/2013 5:45 PM	JPEG image	11,168 KB	
	SC04387JPG	12/11/2013 5:46 PM	JPEG image	9,152 KB	
Vetwork	image_positions.txt	12/11/2013 7:47 PM	Text Document	1 KB	

The example dataset contains 15 jpg-images and one text file.





1. Check the image properties by right-clicking on an image and selecting **Properties > Details**. The dimension of each image is 6000 by 4000 pixels.

anerai	Security	Coldina	Previous Versions	
Prope	rty		Value	^
Ima	ge			
Image	ID			
Dimen	nsions		6000 x 4000	
Width	1		6000 pixels	
Heigh	t		4000 pixels	
Horizo	ontal resolu	tion	350 dpi	=
Vertic	al resolutio	n	350 dpi	
Bit de	pth		24	
Comp	ression			
Resol	ution unit		2	
Color	representa	tion	sRGB	
Comp	ressed bits	/pixel	3	
Can	nera			
Came	ra maker		SONY	
Came	ra model		NEX-7	
F-stop	)		f/5.6	
Ефоз	ure time		1/800 sec.	
ISO s	peed		ISO-100	~
2	a Propertie	e and Per	sonal Information	
veniow	e Pitopetite	s and rea	sonal mornation	

- 2. Next, look for GPS coordinates of the image center in the **EXIF**-information block. Depending on the source of your images, you may find a GPS section inside the image metadata. The provided images of the UAV example dataset also lack this kind of information.
- 3. Compare the properties of the following two JPG images.

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.





#### Step-by-Step guide for the IMAGINE UAV Workflow

No	GPS Information			GPS	S infor	mation i	s pre	sent	
	DSC04	367.JPG Properties	X			D	SC_34	14.JPG Propert	ies
	General Security Details	Previous Versions		G	General	Security	Details	Previous Versions	
	Property	Value	^		Proper	rty		Value	
	Advanced photo				Flash				
	Lens maker				Camer	ra serial num	ber		
	Lens model				Contra	əst		Nomal	
	Flash maker				Brightr				
	Flash model				-	source		Unknown	
	Camera serial number					ure program	1	Unknown	
	Contrast	Nomal			Satura	ation		Nomal	
	Brightness	10.5171875			Sharp			Nomal	
	Light source	Daylight			White	balance		Auto	
	Exposure program	Shutter Priority				metric interp	retation		
	Saturation	Nomal			Digital	zoom		1	
	Sharpness	Normal	=		EXIF	version		0230	
	White balance	Manual			GPS				
	Photometric interpretation	n			Latitud	de		48; 29; 28.37760	0000070
	Digital zoom				Longit	ude		9; 12; 28.954799	99999949
	EXIF version	0230			Altitud	e		437.85	
	File				File				
	Name	DSC04367.JPG	~		Name			DSC 3414.JPG	
	Remove Properties and Pe	ersonal Information					and Per	sonal Information	
		OK Cancel	Apply				(	OK Can	cel

When dealing with images that have GPS, information processing is easy. The GPS information is used directly if you select the option **From EXIF** in the setup project step. There is no need to reference any external files during data processing.

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





#### **Define Orientation Format Processing Step**

You can skip this step if you process datasets that have valid GPS information in the EXIF-header.

To use the orientation information stored in a text file, you need to define the input file structure. Look at the orientation file included in the example data.

1. You can load C:\Users\Public\GEOSYSTEMS\UAV\examples\gravelpit\image positions.txt in any text editor.

Datei	Bearbeiten Suchen Ansicht Kodierung Sprachen Einstellungen Makro Ausführen Erweiterungen Fenster ?
- O I	
1	id, name, x, y, z, omega, phi, kappa
2	1, DSC04367, JPG, 11, 4447656, 48, 1143331, 655, 816, 0, 0, 83, 3
3	2, DSC04368. JPG, 11.4447733, 48.1141304, 654.936, 0, 0, 82.6
4	3, DSC04369. JPG, 11.4447635, 48.1139336, 655.056, 0, 0, 82.7
5	4, DSC04370, JPG, 11, 4447659, 48, 1137339, 654, 79, 0, 0, 82, 4
6	5,DSC04371.JPG,11.4447698,48.1135317,654.744,0,0,83
7	6,DSC04372.JPG,11.4443952,48.1134912,654.494,0,0,82.3
B	7, DSC04373. JPG, 11.4443394, 48.1136503, 653.983, 0, 0, 83
9	8,DSC04374.JPG,11.4443379,48.1138485,654.489,0,0,84
10	9,DSC04375.JPG,11.444324,48.1140484,654.691,0,0,83.2
11	10, DSC04376. JPG, 11.444343, 48.114251, 654.481, 0, 0, 82.6
12	11, DSC04382. JPG, 11.4439038, 48.1145309, 656.508, 0, 0, 82.7
13	12, DSC04383. JPG, 11. 4439131, 48. 1143313, 655. 98, 0, 0, 82. 2
14	13, DSC04384. JPG, 11. 4438935, 48. 1141304, 654. 943, 0, 0, 82. 2
15	14, DSC04385. JPG, 11.4439184, 48.1139322, 654.377, 0, 0, 82.4
16	15, DSC04386. JPG, 11.4439049, 48.1137292, 653.959, 0, 0, 82.8
17	16,DSC04387.JPG,11.4439095,48.1135308,653.706,0,0,82.5

This plain text file contains comma separated values. The actual data values start from the second row. Here concentrate on 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 intelligent, you can skip the camera rotation angles (omega, phi, kappa) for most of the cases. In order to project the final results correctly, you need to know which coordinate reference system is used. In this case, Lat/Lon values are based on **WGS84**. So the **EPSG** code of the underlying coordinate reference system is 4326.

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





2. Click **Toolbox** tab > **Imagine UAV** > **Edit orientation formats** to open the Orientation data formats dialog.

File H	ome Man	iage Data	Raster	Vector	Terrain	Toolbox	Help	o Google	e Earth		
Ø		27	<b>8</b> 9		4			٢	8	3	
IMAGINE Photogramm	lmage etry Equalizer	Spatial Mode Editor*	Maker*		AutoSync Workstation*	Stereo * Analyst*	Maps	Virtual GIS	IMAG UAV		
							88		UAV process		
Contents		Ψ×	2D View#	1					-2		model
8-12 🗖 🖬 20	O View #1									Edit	orientation formats





3. Create a new format definition in the **Orientation Format Editor** by clicking the + button next to the **Available formats** entry. This adds a new row the the formats list. To rename the entry double click on the new entry. Now set the name to Gravelpit.

ibotix (computed)	Orientation el	ements	D	elimiter and line t	o ignore					
ibotix (recorded)	Filename:	1	٢							
ravelpit	Position:			4326						
		Colum		Apply Correction	Offset		Sca	le	Decimal delin	niter
	Longitude:	2	٢		0,00	÷	1,00	\$	-	
	Latitude:	3	-		0,00	÷	1,00	÷		
	Z:	4	-		0,00	a T	1,00	a T		
	Angles:	Use		Type:	RPY	w		Unit:	Degree	Ŧ
	Omega:	14	A V		0,00	÷.	1,00	*		
	Phi:	13	*		0,00	*	1,00	÷		
	Kappa:	12	÷		0,00	÷	1,00	-		
Preview Orientation data	file									

Click the **Delimiter and ignore line** tab. Ensure that **Comma** is used as column delimiter. You also can skip the first line containing the column descriptions. Add a new **ignore line entry** by clicking the + button in the **lines to ignore** group. This adds a new skip entry starting from 1 and ending with line 1. Entries can easily be modified. Select the **ignore** option and modify the start and end options.





Alternatively, you may also set a **comment character** or characters. All lines starting with this character are skipped. You may add any number of skip options.

For your example, the settings in <b>Delimiter and ignore line</b> tab should look as follows:

۶	Orientation data fo	rmats	? ×
Available formats: + -	Format		
Aibotix (computed)	Orientation elements Delimiter and	line to ignore	
Aibotix (recorded) Gravelpit	Delimiters       +     -       Comma     Comma       Semicolon     Space	from	Static line line: to line:
	Combine consecutive delimiters		Comment line
Preview orientation dat	a file		
		ОК	Cancel

5. 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. Find the image center coordinates X, Y and Z in column 3, 4 and 5. Since you are not using the rotation angles, keep this option disabled. The **EPSG-**code of the coordinate reference system is 4326, leading to the following final settings:

vailable formats: + -	Format						
Aibotix (computed)	Orientation el	lements	Delimiter and line	to ignore			
Aibotix (recorded)	Filename:	2	•				
Gravelpit	Position:		SG: 4326 🗘				
		Colum				Scale	Decimal delimiter
	Longitude:		•	0,00		1,00 \$	
	Latitude:	4	•	0,00		1,00 🗘	
	Z:	5	•	0,00	*	1,00 🗘	
	Angles:	Use	Type:	RPY	w	Unit:	Degree 👻
	Omega:	14	4 ¥	0,00	-	1,00 🗘	
	Phi:	13	*	0,00	*	1,00 🗘	
	Kappa:	12	\$	0,00	$\frac{\Phi}{\Psi}$	1,00 🗘	
Preview orientation data	file						

#### 6. Click **OK** to save all modified settings.

The additional options allow you to:

Define a constant offset for all input values (for example, when coordinate have been cut off)





- Define a scale factor for each input value (for example, when the input values are stored in cm but you need to use m for the process)
- Override the decimal delimiter (for example, certain countries are using "," as default decimal delimiter)

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

#### Start Processing

1. Open the run model dialog by clicking **Toolbox** tab > **IMAGINE UAV > Run UAV process**.

File	Home Ma	nage Data	Raster	Vector	Terrain	Toolbox	Help	o Google	e Earth	
Ú	- <b>N</b>	27	6		2					8
IMAG Photogra	INE Image mmetry Equalize	Spatial Mod r Editor*	Maker*		AutoSync Workstation*	Stereo Analyst*	Maps	VirtualGIS	IMAG UAV	
			Con	nmon					88	Run UAV process
Conte	nts	ά×	2D View#	1					-0	View model
B 🗹 🗖	2D View #1									Edit orientation formats

- 2. Specify the following processing options in the dialog:
  - Input Folder: C:/users/public/geosystems/uav/examples/gravel-pit/
  - File Selection Filter: \*.jpg (all jpg files in the Input Folder are selected)
  - Orientation Format: Gravelpit (created in Define Orientation step)
  - 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; takes 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 for example, 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
   – for example, 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 for example, create a new directory C:/users/public/geosystems/uav/examples/gravel-pit/results)
- Set the **DSM** projection to 32632 (UTM zone 32 north/WGS84)





### Step-by-Step guide for the IMAGINE UAV Workflow

	Spatial Model	×
Input Folder		
c:/users/public/geosystems/u	av/examples/	
File Selection Filter		
*.jpg		
Orientation Format		
Gravelpit		~
Orientation File Input (*.txt)		
image_positions.txt		× 👼
Time Offset for GPS-Track		
+00:00:00		
Orientation Accuracy		
high		~
Surface Accuracy		
high		~
Output EPSG		
3857		▲ ▼
LAS Output File (*.las)		
gravelpit-point-cloud.las		× 💣
Mosaic Output File (*.img)		
gravelpit-mosaic.img		× 🖨
DSM Output File (*.img)		
gravelpit-dsm.img		× 🚔
Edit Preview	Run Batch Cancel	Help

The settings should look as follows. Double check before you proceed.





3. Click **Run**. Depending on the power or speed of your PC, the processing can take 20 - 30 minutes to finish. Check the process status in the ERDAS IMAGINE Process List. Each operator reports the current progress.

-			Process List	-	
	Row	Process Title	Status	Progress	^
	2	eWkspace smprocess		0%	
	3	smprocess	Executing Compute Orientation	28%	
					~
	_				>
	Kill	Dismiss Canc	el Cancel All Select None Select All Select	PII Close	Help

#### Display the Results Processing Step

After the process has finished, you can display the three output datasets in the View.

1. Open the mosaic or **DSM** as raster files in the View.







 You can open the computed point cloud (LAS format) in the View by clicking File > Open Point Cloud Layer. As shown, the points are RGB-encoded, meaning that every point has stored the RGBvalue 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, think about using the provided UAV layout instead of the default layout of ERDAS IMAGINE. The UAV layout contains only the most needed functions, as shown below.



#### Using the UAV Operators

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

We are providing a pre-made UAV model that you can open by clicking **View model** in the UAV main menu. This opens 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/imagepositions.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)

As you start the process, your final model should look like this:





# Index

No index entries found.

