



## *Air Photo Ortho Suite / ADS Ortho Suite*

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The Air Photo Ortho Suite and ADS Ortho Suite both include rigorous models used to correct the geometry of analogue and digital cameras and to produce orthorectified air photos. These models compensate for the effects of varying terrain and for the distortions inherent to a camera, such as the curvature of the lens, focal length, perspective effects, and the camera's position and orientation. The computed math model calculates the camera's position and orientation when an image is taken.

### *Module Prerequisites*

The Air Photo Ortho Suite and ADS Ortho Suite are add-on packages to Geomatica. They require Geomatica Core or Geomatica Prime as a pre-requisite.

### *Supported Air Photo Formats*

Geomatica supports the following aerial image formats in Air Photo Ortho Suite (Standard and Digital/Video) and ADS Ortho Suite (ADS):

#### **Standard**

These are images scanned from film or prints. These images often measure 9 inches by 9 inches in size and usually contain calibration (fiducial) marks. Normally, a camera calibration report is supplied with the images. The camera calibration report provides data about the camera; such as the focal length, fiducial coordinates and radial distortion parameters.

#### **Digital/Video**

These are images generated from CCD arrays (Charged Coupled Devices) in digital cameras. A camera calibration report may not be supplied with the images. Most companies that provide calibration services for standard aerial cameras can provide camera calibration services for digital and video cameras. The minimum required parameters are focal length (determined when the lens is set) and chip size (which can be obtained from the camera manufacturer). Oblique imagery is not supported.

#### **Leica Airborne Digital Sensor (ADS)**

The Leica airborne digital sensor (ADS) is a line-scanning sensor that collects images in long strips up to 24,000 pixels wide. This camera can simultaneously collect panchromatic, color, infrared and stereo imagery. All multispectral bands are collected simultaneously providing five-band, co-registered imagery at a common, high resolution.



## Camera calibration

Camera calibration information is essential in the orthorectification of air photos. The camera calibration information includes essential camera parameters, distortions and fiducial mark measurements.

### Calibration Information Entry

The calibration panel has two modes:

- Focal length (FL) and principal point offset (PPO)
- Focal length (FL), principal point of autocollimation (PPA) and principal point of symmetry (PPS)

The following calibration information can be entered:

- Focal length
- Principal point offset or Principal point of symmetry / Principal point of autocollimation
- Radial lens distortion
- Decentering distortion
- Fiducial marks from calibration report
  - Entered as Edge or Corner or Edge and corner positions
- Photo scale
- Select whether or not to apply atmospheric refraction correction
- Select whether or not to apply earth curvature correction
  - Earth radius
- Chip size and y-scale factor (digital/video image projects)
- Apply self-calibration (analog projects only)
  - Deviation limits required for focal length and principal point offset

The camera calibration information can also be exported, using the Tools->Export->Camera Calibration Parameters to XML menu item. If the user has an existing XML file they can easily import that in the Calibration panel.

### Fiducial Mark Collection

- Interactively selects fiducials from scanned images
- Links camera calibration fiducials with selected fiducials



## Ground Control

The OrthoEngine air photo models support imported GPS/INS data and existing triangulation solutions, as well as GCP and tie-point ground control.

### Import GPS/IMU Data

Using the onboard Global Positioning System (GPS) and Inertial Measurement Unit (IMU) you can:

- Skip GCP and tie-point collection
- Import from any sensor system that uses omega, phi, and kappa
- Use GPS/IMU only, or supplement with ground control points, tie points, or both
- Perform kappa rotations
- Manually edit GPS and IMU data

### Import Existing Triangulation Solutions

Using existing triangulation solutions, you can:

- Skip GCP and tie-point collection
- Manually edit existing triangulation solutions

### GCP Collection

GCPs can be collected manually, or automatically by using:

- A geocoded image
- Geocoded vectors
- A chip database
- An imported text file

Other features include:

- Stereo (and multi-way) GCP collection
- Conversion of GCPs to check points to exclude them from model calculation
- Display of individual and overall RMS error for GCPs

### Tie Point Collection

- Extends ground control over areas without GCPs
- Identifies how images in a project relate to each other
- Ensures the best fit for all the images in the project
- Imports and exports tie point locations
- Allows entry of tie point elevations manually or extracts them from a DEM automatically
- Show individual and overall RMS errors



## Bundle Adjustment

Using the option for bundle adjustment settings, found in the Tools menu, you can adjust the methodology used during the model calculation. The following modes are available:

- Traditional block bundle
- Enforced fitting
- Relative-absolute orientation
- Relative orientation
- Absolute orientation
- Free network adjustment

## Residual Report

Using residual reports, you can:

- Show GCP, check-point, tie-point, GPS/IMU and stereo (and multi-way) GCP error information in one report
- Edit points and update bundle adjustments
- View in ground units, photo pixels, or photo microns
- Print the report to a file

## Project Summary Information

### Raw Image Summary Table

A summary of information about all of the images in your OrthoEngine project can be viewed in the Raw Image Summary Table window. This window provides information about the following:

- Total number of images in the project
- Total number of ground control points (GCPs), tie points (TPs), and check points (CPs)
- Image-specific information, including image ID, GCPs, TPs, CPs, root mean square (RMS) error, number of overlapping pairs connected by TPs, number of potential overlapping pairs that could be connected by TPs, and the percentage of all overlaps connected by TPs

The Raw Image Summary Table provides you with a dynamic view of your project, allowing you to better target your quality assurance efforts to achieve your desired project requirements.

Image-specific information is displayed in tabular format. The tabular contents can be sorted, making it easier for you to analyze the data in your project and identify areas on which to focus your quality assurance activities.

The Raw Image Summary Table window displays both active and inactive images in your project. You can activate and deactivate one or more of the images in your project using the check box column. An active image is included in any processing you want to do on your project. When you deactivate an image, it is still in your project, but is excluded from processing. You can also activate and deactivate images in the Project Overview window.



## Project Overview

The Project Overview window provides a graphical display of the raw images in your project, while the Raw Image Summary Table lists all pertinent information in table format. You can use both windows together to gather relevant information about each image in your project, allowing you to better target your quality control efforts and manage your project.

By default, the Project Overview window displays centers of each raw image in project. You can choose to display image centers, geocoded vector footprints, and/or thumbnails of the imagery. You can also toggle the display of ground control points, tie points, and check points, as well as Image and Point IDs, for all images or for selected images only.

Note: When the Raw Image Summary Table is open, the Project Overview window displays the current image with a yellow border and its image ID.

This viewer helps users to better assess their project using a graphical overview. It also includes some simple tools to assist in project management like:

- Ability to display reference imagery or vectors
- Rotating the kappa of the input imagery
- Measurement tools

## Orthorectification

- Can run as a batch process
- Utilizes a DEM for terrain correction
- Can increase the size of the working cache for faster processing
- Can increase the sampling interval for faster processing
- Offers the following resampling methods:
  - Nearest Neighbor
  - Bilinear Interpolation
  - Cubic Convolution
  - 8-pt Sin X/X
  - 16-pt Sin X/X
  - Average filter
  - Median filter
  - Gaussian filter
  - User-defined filter
- Clips the image size upon orthorectification
- Can use a scheduled start time
- Provides approximately one-third of a pixel accuracy for VIR satellite images, and approximately one pixel for radar images when quality ground-control coordinates are used



## Manual Mosaicking

With manual mosaicking, you can:

- Define a mosaic area
- Collect cutlines manually, including:
  - Import and export of cutlines
  - Specified blend width along seams
- Perform manual color balancing:
  - Based on samples identified in overlap between images
  - By using samples (match areas) to compute look-up tables (LUTs) to adjust new images to match an existing mosaic
  - By adjusting the dark end or light end
  - By importing and exporting LUTs for color balancing
- Mosaic unreferenced images

## Other

When working with an airphoto project in OrthoEngine, users also have the ability to import or export their project for use with the following third party software packages:

- BINGO
- PATB

You can import and export:

- Camera-calibration information, such as a distortion grid
- An exterior orientation (EO) file (x, y, and z coordinates of image centers and orientation angles of the photo: omega, phi, kappa)
- Corrected point coordinates and errors (standard deviations)

You can use either of the following recommended workflows:

- Start a project in either BINGO or PATB. After completing point collection and error refinement, import the project into OrthoEngine. You can then perform orthorectification and mosaicking on the project, as necessary.
- Start a project in OrthoEngine. After collecting your tie points (TP) and stereo ground control points (GCP), export to BINGO or PATB.



## Functions

With a license for the Air Photo Ortho Suite, the following functions can be executed either independently or sequentially via an EASI™ or Python™ script. They may also be available in the Algorithm Librarian in Geomatica Focus and the PCI Modeler.

- APMODEL – calculates the mathematical model required for orthorectifying a set of images in an OrthoEngine project file
- CAMEXPORT - export the camera calibration information from an OrthoEngine project file to an XML file.
- CAMIMPORT - imports camera calibration parameters from an XML file into an OrthoEngine project file.
- EOEXPORT - export the exterior orientation data from an OrthoEngine project file into a text file.
- EOIMPORT - import the exterior orientation data into an OrthoEngine project file from a text file.
- FLIGHTLINE - prints flight-line information for all the images in the selected file(s).
- GENAPMODEL - uses camera information, exterior-orientation data, and map units to generate airphoto model segments for multiple files.
- MODEL2RPC - converts a math model to a RPC model

With a license for the ADS Ortho Suite, the following functions are can be executed either independently or sequentially via an EASI™ or Python™ script. They may also be available in the Algorithm Librarian in Geomatica Focus and the PCI Modeler.

- ADSCOPYCORR - copies ADS model-correction terms from one segment to another. For example, the panchromatic ADS model-correction terms can be copied to the multispectral file such that the panchromatic and multispectral models are synchronized.
- ADSLOTOL1 - converts airborne digital sensor (ADS) products from Level 0 to Level 1.
- ADSMODEL - performs a bundle-adjustment computation on photos acquired with an airborne digital sensor (ADS) that have ground control points (GCP) and tie points (TP)

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