

## *Radar Ortho Suite*

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The Radar Ortho Suite includes rigorous and rational function models developed to compensate for distortions and produce orthorectified radar images. Distortions caused by the platform (position, velocity, and orientation), the sensor (orientation, integration time, and field of view) the Earth (geoid, ellipsoid, and relief), and the projection (ellipsoid and cartographic) are all taken into account using these models. The models reflect the physical reality of the complete viewing geometry and correct all distortions generated during the image formation.

### *Module Prerequisites*

The Radar Ortho Suite is an add-on to Geomatica. It requires Geomatica Core or Geomatica Prime as a pre-requisite.

### *Supported Radar Formats*

The Radar Ortho Suite supports the following radar sensors.

- ASAR
  - ASAR 1B format
- COSMO-SkyMed
  - Level 0 (RAW)
  - Level 1A (SCS)
  - Level 1B (DGM)
- ERS 1/2(CEOS)
  - ERS CD provides different levels of processing. We recommend the georeferenced level for images produced in Canada and the PRI level produced by ESA.
- Huanjing (HJ-1C)
  - 1C Level 2 format
- JERS1 (LGSOWG)
  - JERS-1 CD provides different levels of processing. We recommend that you use a georeferenced level or equivalent for highest accuracy. OrthoEngine only works for descending order images.
- KOMPSAT-5
  - L1A SCS\_U: Single Look Complex Slant Un-balanced
  - L1A SCS\_B: Single Look Complex Slant Balanced
  - L1B DSM\_U: Detected, Slant Range, Multilook Un-equalized
  - L1B DSM\_U: Detected, Slant Range, Multilook
  - L1B DGM\_B: Detected, Ground projected, Multilook Balanced
- ALOS PALSAR
  - ERSDAC PALSAR georeference levels L1.5, L1.5 long, L4.1 and L4.2 are supported.
  - JAXA PALSAR georeference level 1.5 is supported.
- ALOS-2 PALSAR
  - JAXA PALSAR-2 georeference level 1.1, 1.5, 2.1, and 3.1 are supported.
- RADARSAT-1 (CEOS):
  - SGC (SAR Georeferenced Coarse Resolution)
  - SGF (SAR Georeferenced Fine Resolution)
  - SGX (SAR Georeferenced Extra Fine Resolution)



- SLC (Single Look Complex)
- SCN (ScanSAR Narrow Beam Product)
- SCW (ScanSAR Wide Beam Product)
- RADARSAT-2 (CEOS)
  - Level 1.1 SLC (Spotlight, Ultra-Fine, Multilook-Fine, Fine, Standard, Fine-Quad-Pol, Standard Quad-Pol, Wide, ScanSAR Wide, ScanSAR Narrow)
  - Level 1.5 SGF (Fine, Standard, Fine-Quad-Pol, Standard Quad-Pol)
  - Level 1.5 SGX (Fine, Standard, Fine-Quad-Pol, Standard Quad-Pol, ScanSAR Wide, ScanSAR Narrow)
- RISAT-1
  - High resolution spotlight (HRS)
  - Fine resolution stripmap (FRS-1)
  - Fine resolution alternate stripmap (FRS-2)
  - Medium resolution ScanSAR (MRS)
  - Coarse resolution ScanSAR (CRS)
- Sentinel-1
  - Level 1 ground range detected (GRD) products
    - Stripmap (SM)
    - Interferometric wide swath (IW)
    - Extra-wide swath (EW)
    - Wave (WV)
- TerraSAR-X / TanDEM-X
  - Level 1b MGD products
  - Level 1b SSC products

## Radar Specific Model

The Radar Specific Model uses the additional parameters in the orbit data to diminish amount of ground control points (GCPs) required. The extra parameters maintain the positional accuracy and high levels of detail in the model, but the number of GCPs needed is reduced to few or none. This math model does not use tie points since each scene is computed using the GCPs of that scene only.

The radar specific model is available for the following types of imagery:

- ALOS PALSAR
- ALOS-2 PALSAR
- ASAR
- COSMO-SkyMed
- KOMPSAT-5
- RADARSAT
- RISAT-1
- TanDEM-X
- TerraSAR-X



## RPC Models

The Rational Function is a simple math model that:

- Builds a correlation between the pixels and their ground locations
- Obtains RPC data with images and imports coefficients automatically
- Calculates the polynomial coefficients from GCPs
- Refine RPC data with one or more GCPs
- Zero- or first-order GCP refinement available

RPC-based corrections are available for the following types of imagery:

- RADARSAT-2

## Ground Control

The OrthoEngine Satellite Models support GCP and tie-point ground controls.

### GCP Collection

GCPs can be collected manually or by using:

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

Other features include:

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

Depending on the sensor, the following minimum number of GCPs is required:

- RADARSAT, ERS, JERS, ASAR, EROS:
  - 8 per image (10-12 recommended)
- RADARSAT with RADARSAT-specific model:
  - GCPs are optional (8 recommended)
- ASAR:
  - GCPs are optional
- Rational Functions Computed from GCPs: - 5 per image (19 per image is recommended)
- Rational Functions Extracted from Image File: - None required (accuracy is improved with 1 or more GCPs)



## Tie-Point Collection

Tie points:

- Extend ground control over areas without GCPs
- Identify how images in a project relate to each other
- Ensure the best fit for all images in a project
- Let you enter tie-point elevations manually or extract them from a DEM
- Let you import and export tie points
- Show individual and overall RMS errors

## Residual Report

Using residual reports, you can:

- Show GCP, check point, tie point, and Stereo-GCP error information in one report
- Edit points in a residual report and update bundle adjustments
- View in ground units or pixel units
- 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

- Let's you perform batch processes
- Utilizes a DEM for terrain correction
- Increases working cache for processing
- Increases 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
- Let's you set a starting time for processing
- 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 by:
  - Importing and exporting cutlines
  - Blending seams using Blend Width
- 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



## Functions

With a license for the Radar 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.

- MODEL2RPC – Lets users convert a math model to a RPC model
- RFMODEL – computes the math model of one or more images using the rational function math modeling method
- RSMODEL - computes the math model of one or more images using the radar-specific modeling method
- SATMODEL – calculates the math model for one or more images using the Rigorous math modeling method.

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