PCI Geomatics

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Orthorectifying ALOS PALSAR

Quick Guide

Features:

- Complete: Photogrammetry, GIS and Cartography Solutions
- Powerful: Over 250 raster and vector processing tasks with batch support
- Quality: Outputs including ortho-mosaic maps, DEMs, and value-added imagery
- Interoperable: Exclusive Generic DataBase (GDB) technology – including Oracle 10g support

Make better decisions about your world with Geomatica

Using this Guide

Data for the ALOS PALSAR data has been downloaded from the JAXA website

http://www.alos-restec.jp/sampledata_e.html

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SAR Processing In Geomatica OrthoEngine

Because of its all-weather and all-day monitoring capabilities, Radar remote sensing offers a number of advantages for Earth-surface and feature observation. Radar sensors can see through cloud and rain and at night, allowing for remote observation at any time. Some features, such as ice, ocean waves, and geological structures can often be seen better in radar images than in optical images.

Over the years, radar remote sensing has provided comprehensive, timely, and accurate information of the Earths surface. Due to the unique nature of radar systems, specific tools are required to extract useable information from the data. The comprehensive radar functions in Geomatica allow you to fully exploit the power of radar for use in a wide variety of applications.

The SAR Specific Model

For orthorectification of SAR data, Geomatica uses the RADAR Specific Model which uses the additional parameters in the orbit data of SAR 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. If you have more than eight well distributed GCPs, both Toutin's Model and the SAR Specific Model will give you similar results.

The following table describes sensor and product levels supported by the SAR Specific Model.

Sensor	Supported Products
ALOS PALSAR	L1.5 SGF L4.1 SGP L4.2 SCN
Envisat ASAR	ASA_IMM_1P: Level 1b Image Mode Medium Resolution ASA_IMS_1P: Level 1b Image Mode SLC ASA_IMP_1P: Level 1b Image Mode PRI ASA_APM_1P: Level 1b Alternating Polarization Mode Medium Resolution ASA_APS_1P: Level 1b Alternating Polarization Mode SLC ASA_APP_1P: Level 1b Alternating Polarization Mode PRI ASA_WSM_1P: Level 1b Wide Swath Mode Medium Resolution
RADARSAT	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)
ERS	Georeferenced for images produced in Canada PRI level for images produced by ESA

About ALOS PALSAR

PALSAR provides higher performance than the previous JERS-1 SAR sensor. In addition to the fine resolution in a convention mode, PALSAR has a ScanSAR observation mode which enables the sensor to acquire a 250 to 350km width of SAR images (depending on the number of scans) at the expense of spatial resolution. This swath is three to five times wider than conventional SAR images. Another advantage of PALSAR is the polarimetric characteristic. Full polarimetric SAR enables more detailed measurements compared to conventional single polarization SAR.

PALSAR Applications

There are numerous applications for PALSAR data. Examples are land area basin mapping, coastal area basin mapping, monitoring of environment and natural disasters such as oil spill and flooding.

One example was an emergency request to monitor flooding in Indonesia in February 2007 (http://www.eorc.jaxa.jp/ALOS/img_up/dis_indonesian_flood.htm).

Another example was to detect oil spill caused by a sunken tanker in 2006 (http://www.eorc.jaxa.jp/ALOS/img_up/pal_oil200608.htm).

Polarmetric application study is steadily in progress in fields such as forest fire monitoring, classification of vegetation (height), water content in vegetation, monitoring of snow cover, condition of ice, flood monitoring and soil moisture.

More applications of PALSAR data can be found at http://www.palsar.ersdac.or.jp/e/index.shtml.

Setting up A PALSAR Project In OrthoEngine

The example gives you an opportunity to work with Geomatica OrthoEngine to carry out orthorectification of PALSAR L1.5G data. Sample PALSAR data for use with this tutorial can be downloaded from http://www.alos-restec.jp/sampledata_e.html

Creating the Project

The first step in correcting your data is to create a project within OrthoEngine. The project file contains information about the images being corrected, as well as projection information and information about the model used to correct your data. There are three main steps for creating a project:

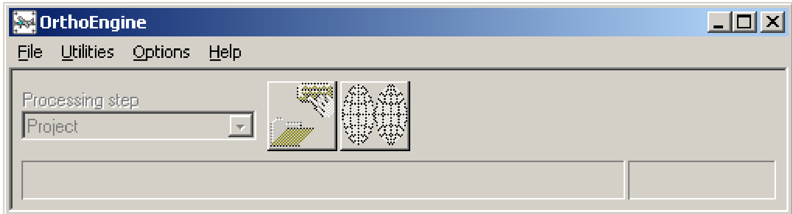
- Selecting the math model
- Setting the projection

- Importing images

The following instructions outline the steps for creating a project specific to working with PASLAR data. This workflow is also much the same for other supported SAR sensors such as RADARSAT and ASAR.

Starting OrthoEngine Windows Systems

To start OrthoEngine on Windows systems click the OrthoEngine icon on the Geomatica toolbar. The main OrthoEngine toolbar opens.

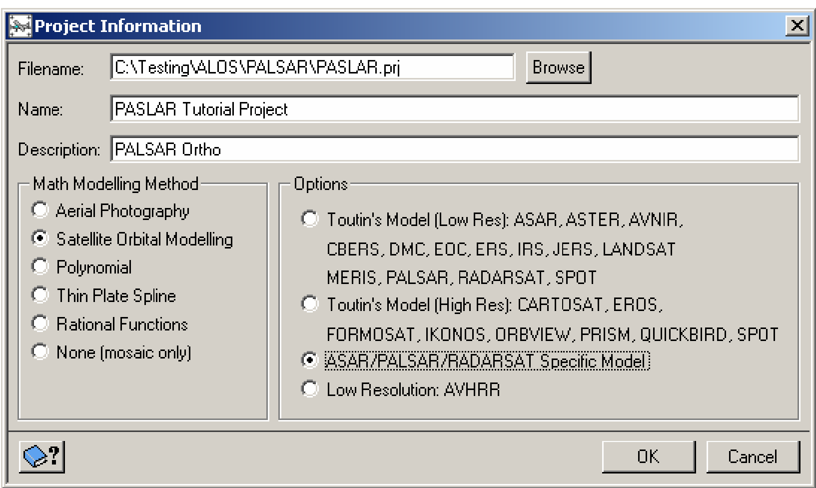


Creating a Project and Importing Radar Data

OrthoEngine works on a project-by-project basis. Therefore, you need to open an existing project or create a new project before you gain access to the functions within OrthoEngine. In this lesson, you create a new PALSAR project.

To create a new project:

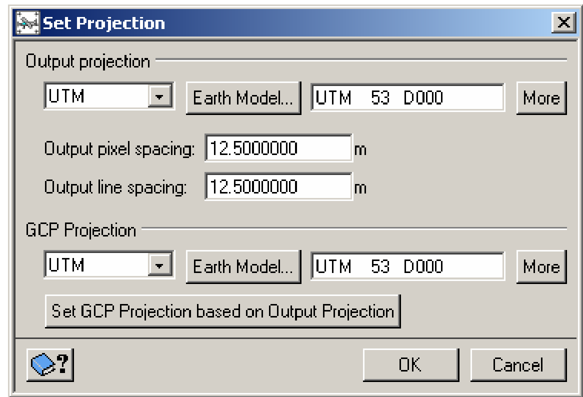
1. Click **New** on the File menu. The Project Information dialog box opens.
2. Click **Browse**. The File to Create dialog box opens.
3. Choose a location to store your PALSAR Orthoengine project.
4. Enter the name **PALSAR.prj** in the File name field.
5. Click **Open**. The File to Create dialog box closes. The path and filename appear in the File name field in the Project Information dialog box.
6. Enter the name **PALSAR Project** in the Name field.
7. In the Description field, type **PALSAR ortho project**.
8. In the Math Modelling Method pane, select **Satellite Orbital Modelling**.
9. In the Options pane, select the **ASAR/PALSAR/RADARSAT Specific Model**.



10. Click **Accept**. The Project Information dialog box closes. The Set Projection dialog box opens.

Setting the Output Projection Parameters

The projection information needs to be set at the beginning of each project. In the Set Projection dialog box, enter the projection information for project.



1. Select **UTM** from the pull-down menu in the Output Projection pane. The UTM Zones dialog box opens.
2. Under the Datums tab, select **D000**.
3. Click **Accept.** The UTM Zones dialog box opens.
4. Click to select **Zone 53 and click Accept**.
5. Click to select **Northern Hemisphere**.
6. Click **Accept**.
7. For the Output Pixel Spacing, type **6.25**.
8. For the Output Line Spacing, type **6.25**. The value of 6.25 meters represents the desired resolution of the ortho images and the mosaic file.

Setting the GCP Projection

1. Click Set GCP Projection based on Output Projection in the GCP Projection section. The GCP Projection adopts the same settings used for the Output Projection.
2. Click Accept. The Set Projection dialog box closes.

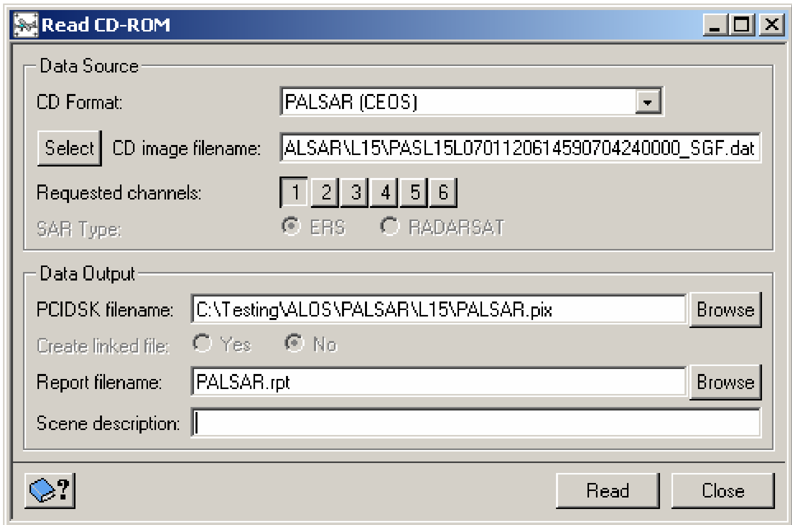
Reading Satellite Images from a CD

Now that you have created the project file, you need to images to your project file. OrthoEngine reads the raw satellite data, saves the imagery into a PCIDSK file, and adds a binary segment containing the ephemeris data (orbit information) to the file. The project file will then contain the filename and location of each input image.

To input the images to the current project:

1. From the **Processing Step** menu on the main toolbar, select **Data Input**.
2. A new toolbar with two icons appears on the main panel. You can input data from either CD-ROM or PCIDSK file.
3. On the Data Input toolbar, click **Read CD-ROM data**. The Read CD-ROM dialog box opens.
4. For the CD Format, select **PALSAR (CEOS)**.
5. Click **Select** beside CD Image Format. A File Selection window opens.
6. Navigate to the folder containing your RAW L1.5 PALSAR data

7. Select the file ***.DAT file**. (e.g. PASL15L0701120614590704240000_SGF.dat)
8. Click **Open**. The path and filename are updated in the dialog box.
9. For the Requested Channels, click **1**.
10. For the PCIDSK File name, browse to your desired output directory and give the file an output *.pix filename. A report file will also be created.
11. Click **Read**. Once the file is read, it is part of your project.
12. Repeat steps **4** to **11** to read data from additional raw scenes you may want to add



Saving your Project

1. Click **File** on the Menu bar.
2. Click **Save** on the File menu.

The project file PASLAR.prj is saved in the specified folder. In addition, OrthoEngine automatically creates a backup file every 10 minutes. The backup file uses the same file name as your project file, but with a *.bk* extension.

Tip
If you need to revert to the backup file, rename the backup file so that it uses the *.prj* extension. OrthoEngine can load this project file in the normal way.

Orthorectifying PALSAR Data

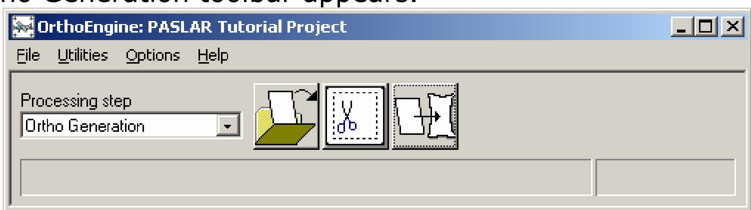
When working with the ASAR/RADARSAT Specific Model, ground control points (GCPs) are optional. Without any GCPs, the model is calculated based on the satellite's positioning information. The addition of ground control points, although not necessary, will refine the model and improve its accuracy. This means, however, that as long as you have a DEM, or have extracted a DEM from stereo radar images, you can still orthorectify your radar data without any ground control.

Setting up for Orthorectification

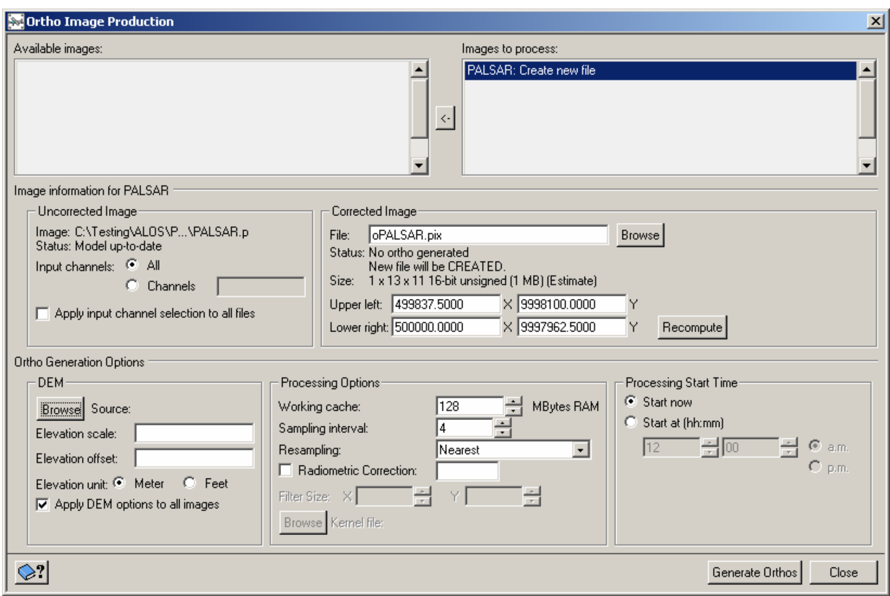
The Ortho Image Production dialog box allow you to set up and schedule the images for orthorectification. Several images can be selected and processed in batch mode.

To set up the images:

1. From the Processing Step menu, select **Ortho Generation**.
2. The Ortho Generation toolbar appears.

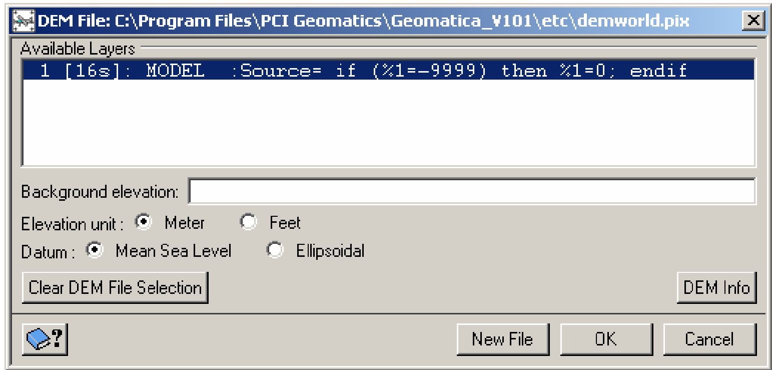


3. On the Ortho Generation toolbar, click **Schedule ortho generation**. The Ortho Image Production dialog box appears.
4. Select all images in the Available Image list.
5. Click the **arrow** to move all the photos to the Images to Process list.
6. By default, the ortho image will be named *ofilename.pix*. You could also enter a different filename in the Corrected Image pane.



Selecting the Digital Elevation Model

1. In the DEM pane, click **Browse** beside Source.
2. Locate the folder containing the DEM you are going to use for orthorectification and select it. If you do not have a DEM for your dataset you can use the **demworld.pix** file located in the Geomatica etc directory
3. Click **Open**.
4. The Database Channels dialog box opens.
5. Select the layer containing the DEM



6. Click **Select** in the Database Channels dialog box.

The Database Channels dialog box closes and the DEM is selected.

Orthorectifying the RADARSAT-1 Scenes

To generate the ortho images:

1. At the bottom of the Ortho Image Production dialog box, click **Generate Orthos**.

The Ortho Production Progress monitor opens and shows the status of the orthorectification process for each image. After all the orthos are generated,

2. Click **Close** at the bottom of the progress monitor.

The message *Ortho done* appears beside each image in the Available Images pane, indicating that the original images are now orthorectified.

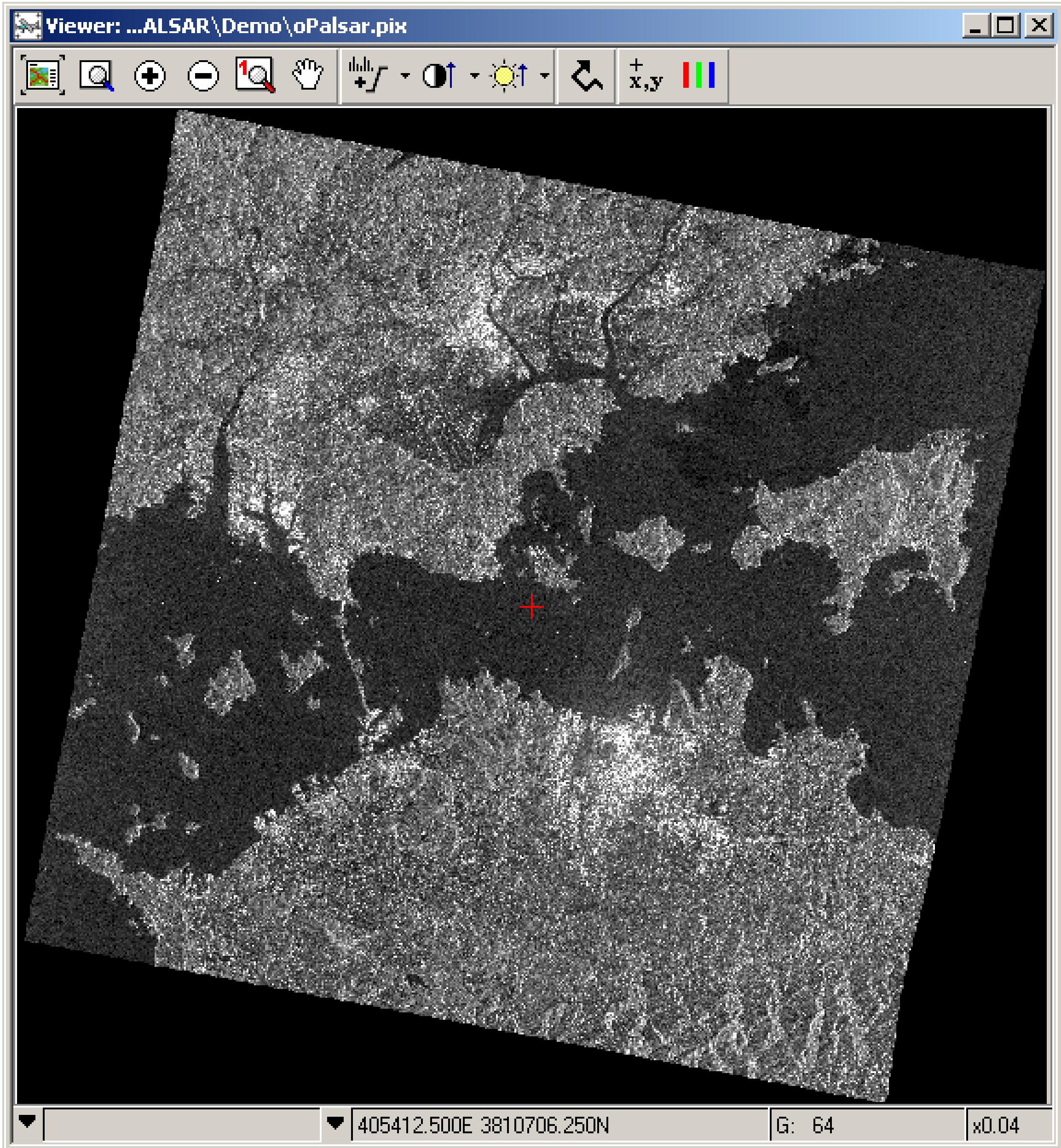
Note

This is a good time to save your project file.

Viewing the orthorectified image in OrthoEngine:

1. From the OrthoEngine File menu, select **Image View**. A Database File Selection window opens.
2. From the Radar_Data folder, select output image.
3. Click **Open**.

A Viewer opens displaying the orthorectified and radiometric terrain corrected image. Note the large No Data areas in the image due to layover.



Further Processing

There are a number of other SAR processing workflows available in the Geomatica suite of software. For example, The RADAR DEM Extraction package allows you to create Digital Elevation Models (DEMs) from stereo RADAR data. Image correlation is used to extract matching pixels in two overlapping images and then use the sensor geometry from a computed math model to calculate x, y, and z positions. RADAR DEM extraction allows you to batch epipolar generation, batch the DEM extraction process, geocode DEMs, and create absolute or relative DEMs. DEM extraction in OrthoEngine is possible if you have stereo imagery.

Updated: 7/19/2007

Other workflows such as Radiometric Correction, SAR texture analysis, SAR Classification, and SAR Change Detection are possibly in Geomatica 10.1 as well Below is an image of some sample SAR workflows possible within the Geomatica Visual Modeler environment. This model is available for download via the PCI Geomatica Model and Script exchange which can be found here: http://www.pcigeomatics.com/services/support_center/models/models_main.php