

Image Analysis for ArcGIS FAQs¹



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Remote Sensing Applications Center

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How Do I OrthoCorrect Landsat and SPOT Imagery?

Use Image Analysis for Landsat and SPOT satellite image orthorectification in ArcMap. Orthorectification is a form of geometric correction that removes distortions inherent in imagery. The process makes your satellite image conform to a map projection, and includes correcting for terrain displacement. This document describes orthorectification of Landsat and SPOT satellite imagery using Image Analysis.

What You Will Need and Other Assumptions

- An uncorrected Landsat or SPOT image
- A Digital Elevation Model (DEM) covering the area
- A Digital Orthophoto Quadrangle (DOQ) covering the area
- You may need to mosaic DEMs and/or DOQs to cover the area of interest
- You may need to reproject DEMs and/or DOQs to match projections

Overview of Steps

1. Add the reference and uncorrected images to ArcMap.
2. Specify the appropriate geometric correction model.
3. Specify the correct model parameters.
4. Establish Ground Control Points (GCPs) between the uncorrected image and the reference DOQ.
5. Edit the GCPs.
6. Inspect the results.

Step-by-Step Example

1. Start ArcMap from your Desktop, or on the Windows Taskbar click **Start | Programs | ArcGIS | ArcMap**. Ensure the Image Analysis extension is visible. If not, from ArcMap's main menu select: 1) **Tools | Extensions** and enable **Image Analysis**; and 2) **View | Toolbars** and enable **Image Analysis**.
2. Click the **Add Data** button on the main toolbar of ArcMap to add your reference and uncorrected images to the Data Frame (**Important: load the reference image first**). Click **OK** to dismiss the Spatial Reference warning.
3. **Right-click** on **Layers** in the Table of Contents, and select **Properties** and then the **Coordinate System** tab. Ensure the coordinate system and projection matches that of your reference image. Click **OK** or **Cancel**.
4. In the Image Analysis toolbar, set **Layers** to your uncorrected image and **Model Type** to either SPOT or Landsat depending on which type of image you are orthorectifying.
5. From the Image Analysis toolbar, click the **GeoCorrection Properties** button to open the SPOT or

¹ Produced by the USDA Forest Service RSAC (<http://fsweb.rsac.fs.fed.us>). A Forest Service version of Image Analysis for ArcGIS was used to develop this reference document. No warranty is made as to completeness or accuracy.

Landsat Properties dialog. In the General tab, set an appropriate **Link Coloring Threshold** and **Colors**. The Link Coloring Threshold allows you to set an acceptable GCP RMS (Root Mean Square) error threshold. *Note: RMS errors are reported in pixel units of the uncorrected image. If you are orthorectifying a Landsat TM image and want the output to be accurate within 30 meters, the RMS error (or the Links Coloring Threshold) should not exceed 1.00 pixels.*

6. Select the **Elevation** tab of the SPOT or Landsat Properties dialog. Set the **Elevation Source** by enabling the **File** option, and then navigate to and select an appropriate DEM.
7. Select the **Parameters** tab of the SPOT or Landsat Properties dialog. Specify appropriate **Sensor** parameters. These parameters differ between the SPOT and Landsat models, and it is also a function of how the imagery was acquired. Make sure you obtain this information from the data provider.
8. Click **Apply**, and then **OK** to close the dialog.
9. From the Image Analysis toolbar, click the **Add Links** button. The image will stretch and conform to the extent of the reference DOQ.
10. Toggle, pan and zoom images in the Data Frame until you identify suitable locations for GCPs.
11. To establish a GCP: 1) Ensure the **Add Links** button is active from the Image Analysis toolbar; 2) Click on a feature in the uncorrected image; 3) Toggle off the uncorrected image in the **Table of Contents**; and 4) Click on the corresponding feature on the reference DOQ. *Note: initial GCP placement should just be close—you can edit these to more precise locations later.*
12. Collect GCPs in an attempt to establish a sufficient number of points, well-distributed across your uncorrected image. *Note: after the 3^d GCP, Image Analysis can solve the Transformation Model and place the image in its true map position. It is also important to note that in many cases we have found that if you establish more than 4 GCPs while orthorectifying a Landsat scene using the Landsat Model, the procedure suddenly terminates. If this happens, you have two options—1) Use ERDAS Imagine to orthorectify the Landsat Image, or 2) Start the orthorectification process over again using Image Analysis, but only use 4 GCPs in your model. We are not sure as to the cause of this problem; however, Leica Geosystems is currently investigating this issue.*
13. After you have collected enough GCPs, click the **GeoCorrection Properties** button from the Image Analysis toolbar and select the **Links** tab. Evaluate the **RMS errors** of each link as well as the **Total RMSE**. If the error values are high (above your specified threshold), GCP editing is necessary. If the error values are below your specified threshold, GCP editing is not necessary. Select **OK** to close the Geocorrection Properties dialog.
14. For editing GCPs: 1) Zoom in to any portion of your uncorrected image; 2) Click the **Add Links** icon from the Image Analysis toolbar; 3) **Right-click** over the image; and 4) Select **Pan to Worst Link**. This will display the link with the highest RMS error.
15. From the Tools toolbar, select the **Arrow** (Edit Vertices) button to edit links. *Note: if this toolbar is not visible, from ArcMap's main menu select: 1) **Tools | Extensions** and enable **Tools**; and 2) **View | Toolbars** and enable **Tools**.*
16. Click the link being displayed. Move the link so that its head points to the GCP on the DOQ, and its tail to the GCP on the uncorrected image. Toggle the images on and off as necessary to identify correct locations. *Note: as you adjust the position of the link, its color may change indicating that this GCP is within the specified RMS error threshold you set in Step 5.*

17. To move to the next link, ensure the **Add Links** button is active, **Right-click** on the uncorrected image and select **Pan to Worst Link**. Edit this link as described above. Continue to edit the links until all are less than your specified RMS error threshold (as indicated by their color change).
18. After you have edited your GCP links, click the **GeoCorrection Properties** button from the Image Analysis toolbar and select the **Links** tab. Evaluate the RMS errors again. Ensure that they meet your project's standards. If not, follow steps 14-17 for further GCP editing.
19. From the Image Analysis toolbar, select **Image Analysis | Options**. Click the **Cell Size** tab. Ensure that the **Analysis Cell Size** field is set to **Maximum of Inputs**. Click the **Preferences** tab. Ensure that the **Resample Using** field is set the **Nearest Neighbor**. Click **OK**.
20. From the Image Analysis toolbar, select **Image Analysis | Save As**. Specify an appropriate filename and location, and click **Save**.
21. Inspect the results—open a new project and compare your orthorectified image with the reference DOQ.

*Note: to change the background value from black to transparent, **Right-click** on the photo in the Table of Contents, select **Properties** and then click the **Symbology** tab. Enable **Display Background Value**. Click **OK**. For more tips on how to inspect the quality of your orthorectified satellite images using ArcMap, see the FAQ **Is There a Swipe Utility in ArcGIS?**.*