

What's New

Image Analysis™ for ArcGIS 9.2 and Stereo Analyst® for ArcGIS 9.2

STEREO ANALYST FOR ARCGIS

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Photogrammetry Project Support

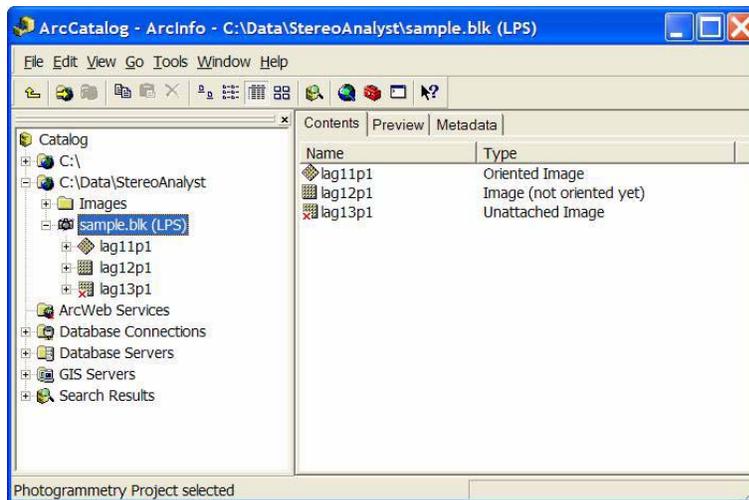
The following chart summarizes the improvements for supporting photogrammetry projects inside the Stereo Analyst® for ArcGIS 9.2 release. More information on each topic is included on the following pages of this document.

<p>ArcCatalog Support</p>	<p>ArcCatalog now recognizes and allows you to browse the contents of photogrammetry projects. While browsing, the statuses of the images are indicated by various icons allowing you to see at a glance the state of project contents. You can click on the Preview tab to view the block of images currently online that make up the project.</p> <p>Stereo Analyst MUST be enabled in ArcCatalog in order for ArcCatalog to be able to recognize a photogrammetry project file. Go to tools - extensions to enable the extension. If you have the extension also enabled in ArcMap, enabling it in ArcCatalog will not consume a second Stereo Analyst license.</p>
<p>Project Repair</p>	<p>The Photogrammetry Project Importer Wizard will allow for the repair of broken paths stored in project files by file selection. Manual editing of data paths prior to import is no longer required. The changes are not applied to the project file, but held in memory until the importer successfully orients the data.</p> <p>In the case of SOCET project files, if the project file resides in a parent folder relative to all of the other support and image files, an option is available from ArcCatalog to repair the project. If the data does not conform to that structure, you will be given a dialog to locate the images. The project and .sup files will be corrected. Backup copies of the original files will be made automatically.</p>
<p>New Photogrammetry Project Importer</p>	<p>Individual photogrammetry project importer dialogs have been replaced with a single Wizard that steps you through the import process. A cell array will allow you to see which images are online and contain the proper information for importing. It will also allow you to reestablish the link to the Digital Elevation Model (DEM) as well as specify the horizontal and vertical coordinate systems if it did not carry over in the project format.</p> <p>The new Wizard supports a plug-in architecture that allows new importers to be added.</p>
<p>Documented Plug-in Layer for defining new importers</p>	<p>A COM API and component category registration now make it possible for developers to add support for custom or previously unsupported photogrammetry project formats.</p>

ArcCatalog Support for Photogrammetry Projects

Stereo Analyst for ArcGIS now enables ArcCatalog and the dialog launched from the Add Data button in ArcMap to recognize photogrammetry projects and display the status of the images linked within. Supported formats include:

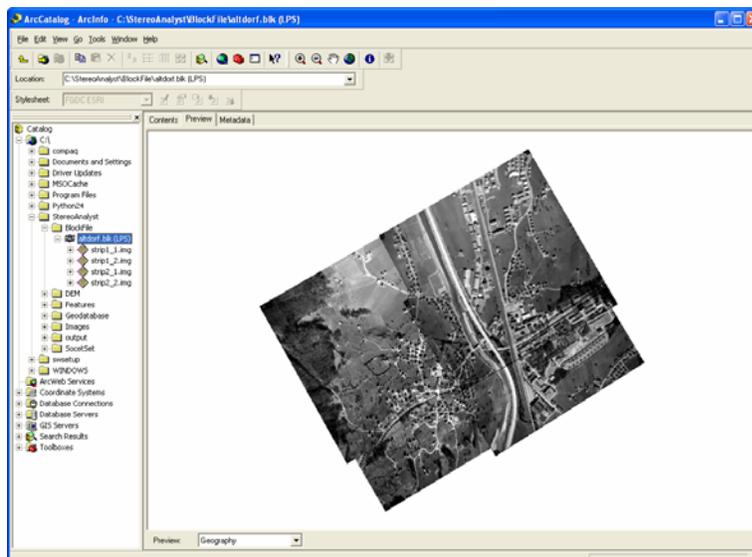
- LPS Block File (.blk)
- SOCET SET project file (.prj)
- ISAT project (folder)
- Match-AT (.prj)
- IKONOS (metadata.txt)



ArcCatalog displaying a sample LPS Block File contents. In this view, we can easily see that one image is already oriented, one is not oriented, and finally the image with the icon containing the "x" has no information available due to a broken path to the image.

More information concerning the image icons and their meanings is available in the next section.

The image that is already oriented, may be added directly to ArcMap using the Add Data button. The other two images will have to be imported via the photogrammetry project import wizard in order to orient and repair broken links.



When the paths to the images are valid inside of a photogrammetry project, the project may be previewed inside ArcCatalog from the preview tab.

Note: Performance is tied to the number of images in the project. Large project files will be slow to display.

At a glance, ArcCatalog indicates three of the four potential states of photogrammetry project contents. They are:

	Oriented Image	Indicated as rotated raster dataset icon. This icon indicates that the path to the image is correctly stored in the project file and that the image has already been oriented. This image may be directly added to ArcMap via the add data button and viewed in stereo without the need for importing.
	Image (not oriented)	Indicated using the standard Raster Dataset symbol. This icon indicates that the path to the image is correctly stored in the project file however the image itself has not yet been oriented. It will be necessary to use the importer to convert this image into an oriented image.
	Unattached Image	Indicated as a standard Raster Dataset symbol with the addition of a red cross in the lower left corner. This icon indicates that the path to this image as stored in the project file is incorrect and that the photogrammetry project requires repair.
	Unattached oriented Image	This situation can only be indicated as an Unattached Image, it will not be possible to determine if the image is oriented or not until the broken image path is repaired in the project file.

Photogrammetry Project Repair & Localization

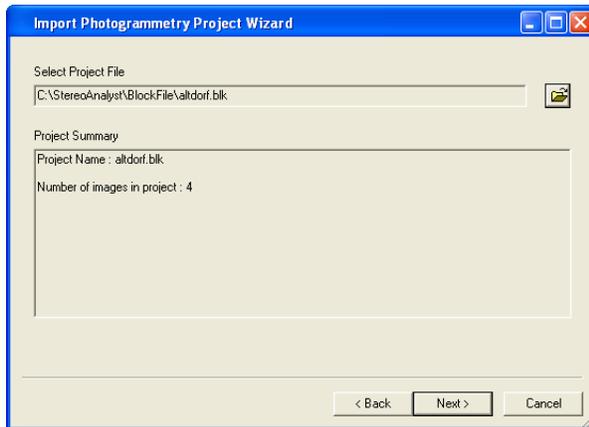
Photogrammetry projects are typically made up from a collection of files related to each other through common location and/or by data structures maintained within those files. An example of such cross referencing is found in LPS Block files, which explicitly reference image files by a stored path.

Photogrammetry Project Repair

It often happens that once a photogrammetry project is created, the collection of files that make up the project will be copied between computers or across networks thus rendering the paths stored in the project files invalid.

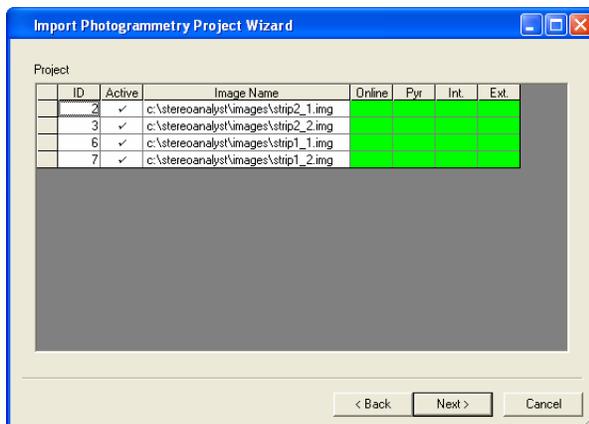
The following diagram illustrates the File Path relationships that may be found in a photogrammetry project with imagery from Leica's digital airborne sensor, the ADS40. As these projects are copied between systems, the stored file paths will typically need to be updated to reflect the new location. For SOCET files, if the project file resides in a parent folder relative to all of the other support and image files, the project can be repaired automatically. Otherwise, a dialog will be displayed to allow for the specification of the new locations for project data (in this example, maintained in the .prj file, image paths and other supporting file paths, the .sup files).

Importer Wizard Operation



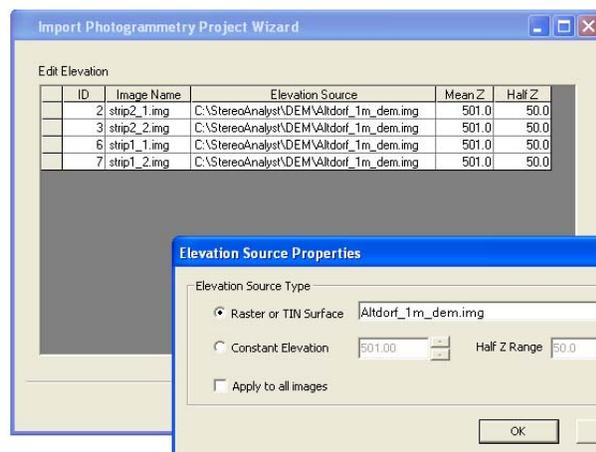
Click on the open button and a dialog will be displayed allowing selection of a photogrammetry project.

A check is performed on the selected project to check for broken links. If it finds broken links, it will allow you to advance to the next dialog to select via file chooser.



The main cell array dialog indicates the data path for each image in the project. It is possible to exclude images from the import process by un-checking the appropriate cell in the Active cell column.

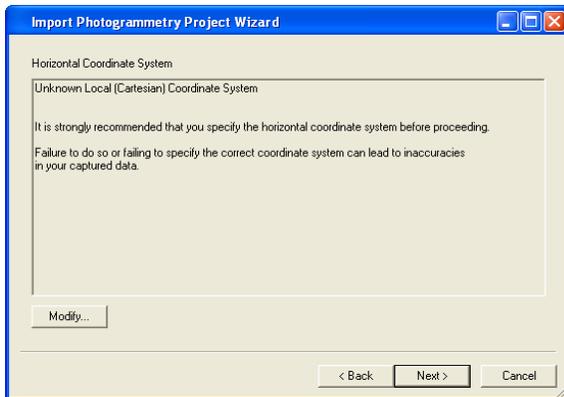
The remaining cells indicate the status of Pyramid layers and whether or not orientations have been found for each image within the project. To build missing pyramids, click in the pyr column and set your preference. The pyramids will be computed after finishing the wizard.



This page allows the user to assign or edit the Mean Ground Elevation (Mean Z) and variation or specify an elevation file.

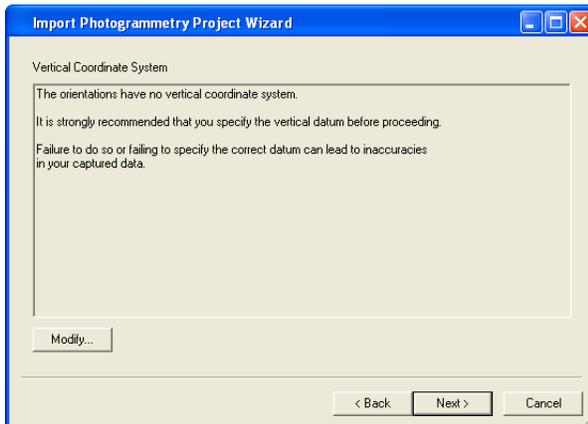
The Elevation Info is used by the software for the following:

- Terrain Following Cursor
- Optimizing Projection Transforms
- Image Display in the ArcMap Document

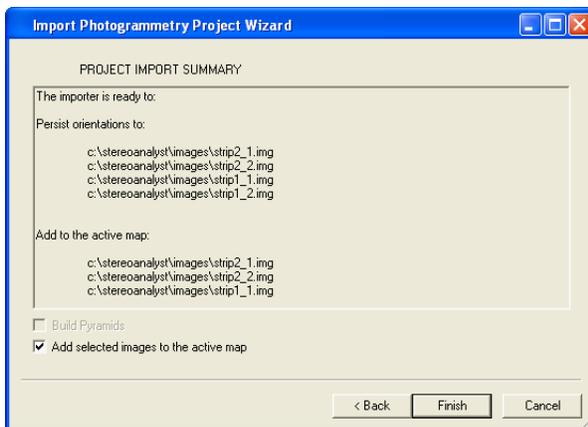


The Horizontal Coordinate System page provides an opportunity to redefine the Horizontal Coordinate system should one not be available from the photogrammetry project.

Without a valid Coordinate system defined, map projection transformations will not be possible between the oriented images and the ArcMap Document.



The Vertical Coordinate System page provides an opportunity to define the vertical coordinate system for the oriented images.



The final page provides summary information about the processes that will be performed once the Finish button is pressed.

Photogrammetry Project Plug-In Architecture

Stereo Analyst for ArcGIS' support for Photogrammetry Projects is built on a plug-in architecture to enable customization. Developers can build custom libraries to support proprietary or custom photogrammetry projects and files.

Custom projects need to implement a small number of COM interfaces that pass information to Stereo Analyst for ArcGIS on the following:

- Project Horizontal and Vertical Coordinate System
- Image locations and state (e.g. pyramids present)
- Orientation information to be applied to each image (interior and exterior)
- Elevation information for each image (source, mean elevation and variation)

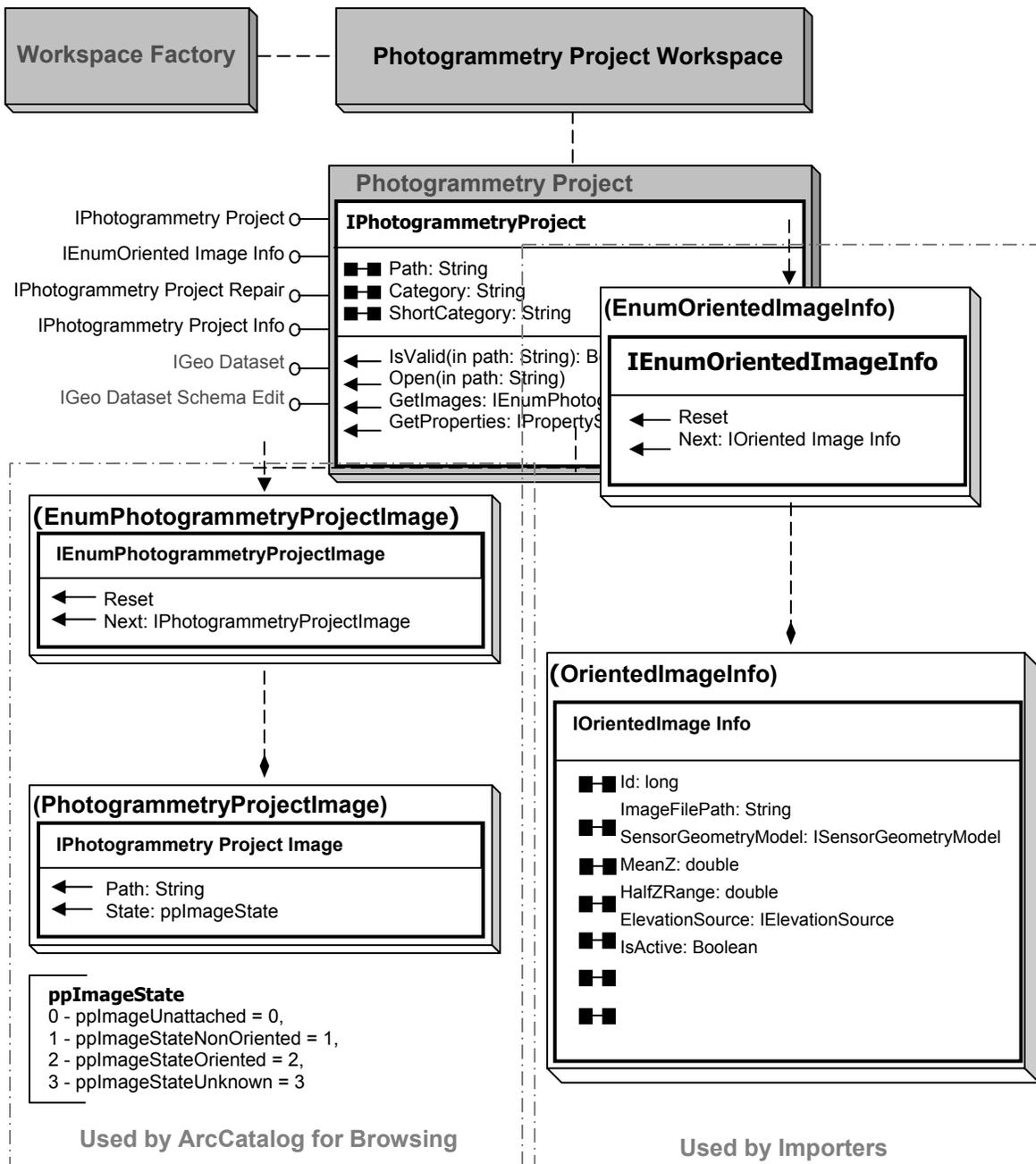
Additional optional interfaces enable project repair and localization.

The Project Importer is also extensible. You may want to collect and/or present additional information supported by your custom project object and you can do this by implementing your own wizard property pages.

Custom projects and importer wizard property pages are recognized automatically by the Import Wizard when they are registered in the component categories provided by the extension.

Importer Plug-In Object Model (Abridged)

A custom Photogrammetry Project Object encapsulates the knowledge of the structure of a photogrammetry project and is able to open and navigate the project data structures. Internally a list of images and orientation metadata is maintained and served out through mandatory and optional interfaces implemented by the object. The Photogrammetry Project Objects serve the requirements of both ArcCatalog Browsing and ArcMap Project Import.



Advanced Editing Tools

A new Stereo Advanced Editing Toolbar has been added to the list of available toolbars for Stereo Analyst for ArcGIS 9.2. These tools have been designed to provide better control over the handling of Z values while editing features. The toolbar contents and operations are described below:

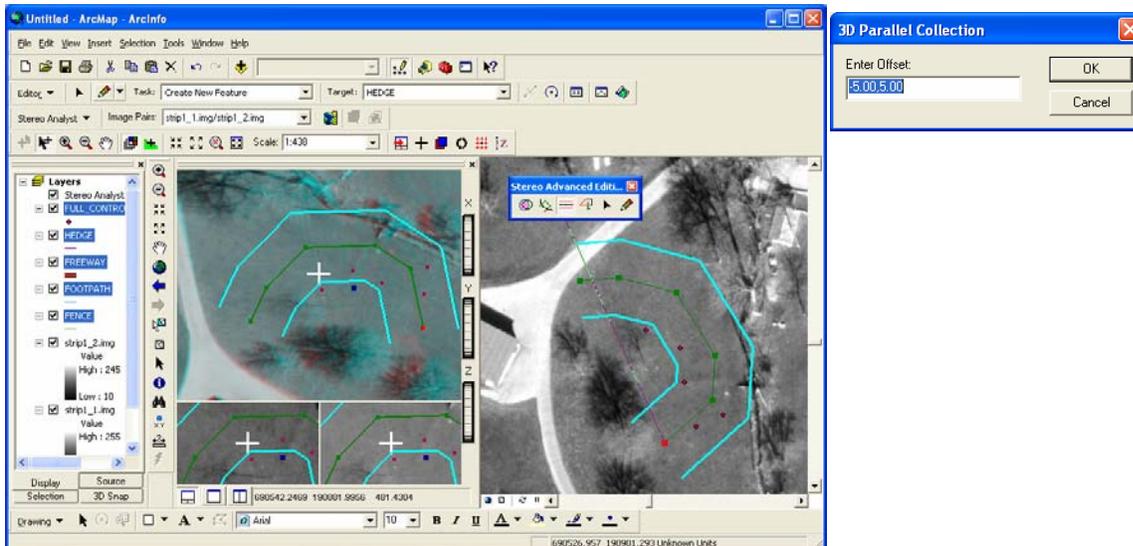


3D Trace Tool (see Description below)

- Trace along an existing 3D feature
- Option to specify parallel offsets
- 3D Parallel Tool (See description below)
 - Simultaneously collect any number of lines parallel to edit sketch
 - User Specified (Multiple) Offsets
- 3D Reshape Tool
 - Similar to standard Reshape Edit Task +
 - Z Values not changed by interpolation between intersections
- 3D AutoComplete Polygon Tool
 - Similar to standard Auto-Complete Edit Task +
 - Z Values not changed by interpolation between intersections

3D Parallel Collection

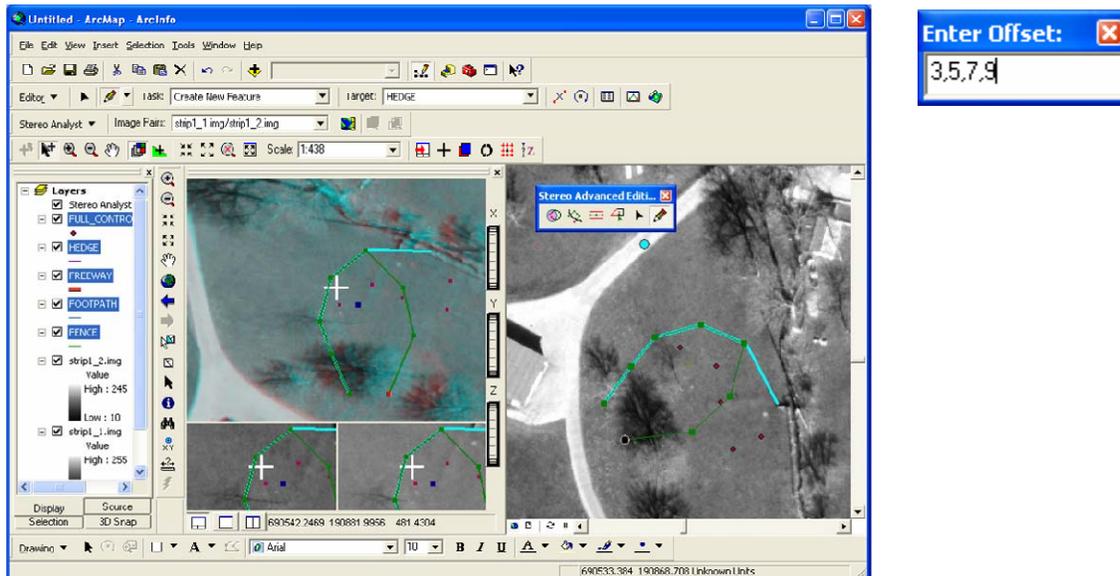
The 3D Parallel Tool provides the capability to collect multiple offset polyline features from a single Edit Sketch Geometry. The Z Values of the parallel features are the same as those of edit sketch for each corresponding vertex. A configuration dialog allows entry of comma delimited offset values. The sign of the offset values indicates if the parallel geometries are constructed on the left or right of the edit sketch geometry.



3D Trace Tool

The 3D Trace tool works similarly to the existing ArcGIS Editor Trace Tool with the added enhancement that it also duplicates the template feature's Z values. The Tool provides a dialog for entry of one or more offset values. It is possible to trace multiple offsets simultaneously.

A configuration dialog allows entry of comma delimited offset values. The sign of the offset values indicates if the parallel geometries are constructed on the left or right of the edit sketch geometry.



3D Reshape Tool

This tool will automatically select the Sketch Tool and set the Edit Task to the 3D Reshape Edit Task. The 3D Reshape Edit Task ensures that the Z values provided through the reshape edit sketch are not discarded for interpolated values. Where the Edit Sketch intersects existing selected geometry, the intersection vertices Z values are interpolated from the nearest edit sketch vertices.

3D Auto-Complete Polygon

This tool will automatically select the Sketch Tool and set the 3D Auto-complete Edit Task. The 3D Auto-Complete Edit Task ensures that Z values provided through the edit sketch are not discarded for interpolated values. Where the Edit Sketch intersects existing selected geometry, the intersection vertices' Z values are interpolated from the nearest edit sketch vertices.

Enhanced Coordinate System Support

Stereo Analyst for ArcGIS 9.2 provides enhanced support for Coordinate Systems and their transformations. While ArcGIS 9.2 now supports the specification of Vertical Coordinate Systems (VCS) for feature datasets (in ArcCatalog), implementation of support for VCS within the ArcMap Document and Editor is not available for this version of ArcGIS. It is for this reason that an alternative solution for defining output VCS has been added to Stereo Analyst for ArcGIS.

Vertical Coordinate Systems

Generally frame photography has been triangulated based on control point coordinate systems (Horizontal and Vertical) that are the same as that desired for features collected from the imagery, however this situation has changed due to:

- Use of Satellite Imagery for which orientations are based on WGS84
- Use of Digital Cameras with integrated GPS and Inertial navigation systems producing orientations based on the WGS84 datum
- National Height networks remain based on orthometric (gravity based) heights for practical purposes.

For this reason, it has been necessary to implement support for vertical coordinate system transformations within Stereo Analyst for ArcGIS.

In addition to this, some legacy oriented Images will not have VCS explicitly defined in their coordinate system definitions. For this reason, the new Photogrammetry Project Importer Wizard provides a property page for the definition of VCS. Note that in order to facilitate Vertical Coordinate system transformations, the input and output VCS must be defined.

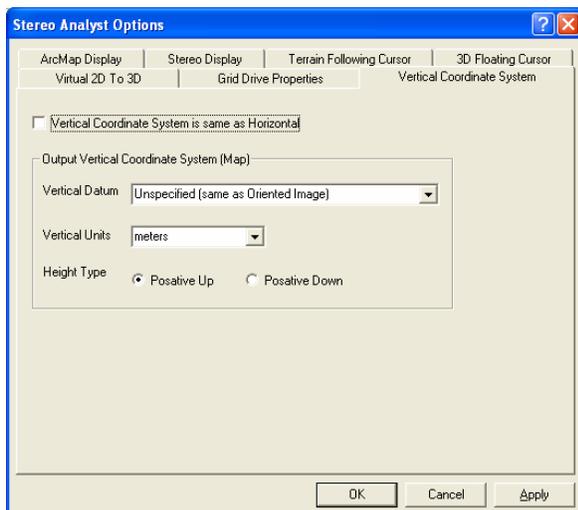
Horizontal Coordinate Systems

A new feature of the map projection support for ArcGIS 9.2 is the introduction of the Local Coordinate System. This coordinate system is equivalent in the 2D sense with the Leica Geosystems' 3D LSR coordinate system. As such bi-directional translation between LSR and Local Coordinate systems has been added to Stereo Analyst for ArcGIS 9.2.

One significant advantage of this enhancement is that ADS40 imagery, which is based on LSR coordinate systems, may be re-projected by ArcGIS into the Spatial Reference defined for the ArcMap Document.

Vertical Coordinate System Property Page

Stereo Analyst for ArcGIS 9.2 now includes a new Stereo Analyst Options property page that allows for the specification of output Vertical Coordinate System for collected features. For cases where the VCS required for the target map base is different from that defined within the orientation information of stereo imagery, this property page may be used to define the desired target VCS. Stereo Analyst for ArcGIS will convert elevations acquired from the stereo imagery into the datum required for the map base.



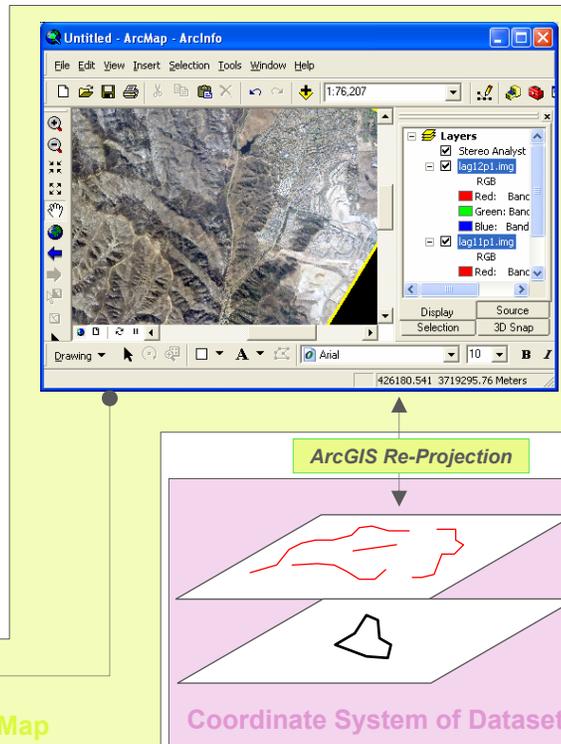
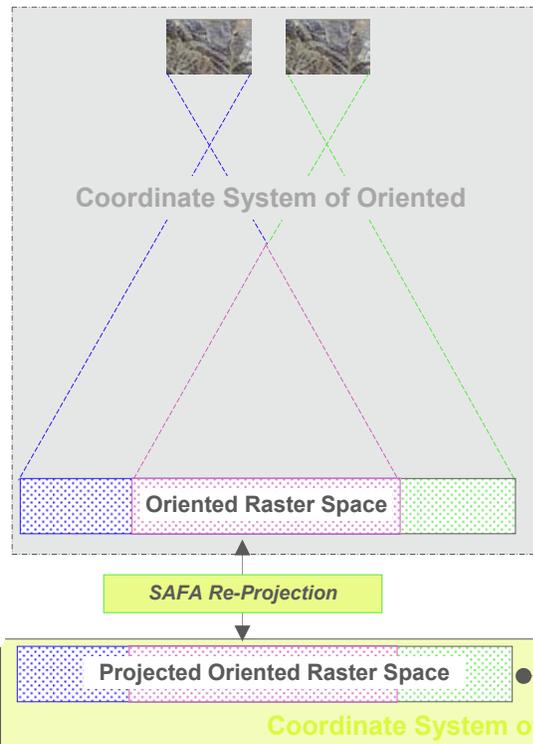
Vertical Coordinate System properties

- Specifying *Vertical Coordinate System same as Horizontal* will cause oriented image heights to be passed directly through to the ArcMap Document
- Unchecking Vertical Coordinate System is same as horizontal and leaving Datum as unspecified, allows you to manipulate the output vertical units, e.g. oriented Image heights may be changed from meters to feet.
- Specifying a vertical Datum and Units will result in vertical datum conversions being applied.

Coordinate System Transformations in Stereo Analyst for ArcGIS

When all elements of horizontal and vertical coordinate systems are defined for the oriented imagery and output coordinate system, the software will perform appropriate coordinate transformations such that features extracted from oriented images are presented to ArcGIS in the same Coordinate System as that defined for the ArcMap document.

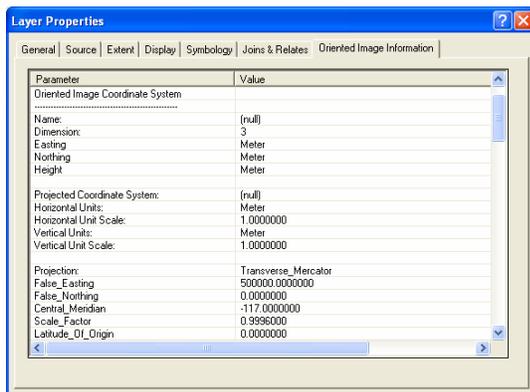
Coordinate system transformations are potentially computationally intensive and have the potential to slow performance; therefore the software automatically optimizes these transformations where possible using polynomial generalization of the transformation.



The Projected Oriented Raster Space implements 3D Coordinate System Transformation

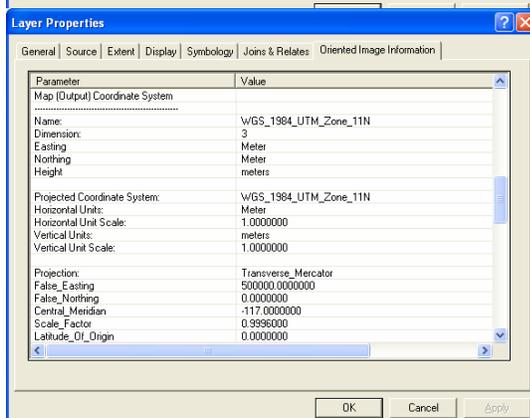
Oriented Image Information Property Page

A new Oriented Image property page has been added to the Layer Properties Dialog to facilitate the inspection of oriented image metadata. This property page is particularly useful for the purpose of inspecting the coordinate system information for oriented images that have been added to the ArcMap Document.



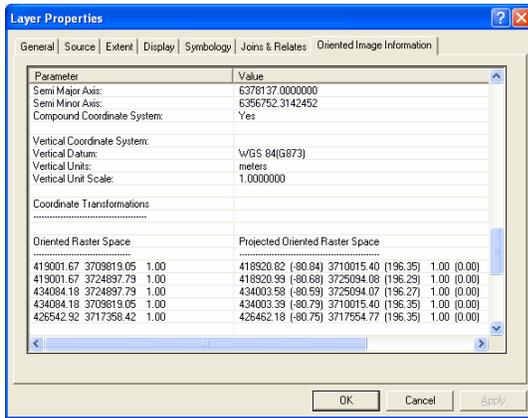
The horizontal and vertical coordinate system details for the oriented image are reported in the first section of the oriented image information.

When using legacy oriented images, it is good practice to inspect the Vertical Coordinate System definition.



The horizontal and vertical Coordinate system details for the ArcMap Document are reported as well.

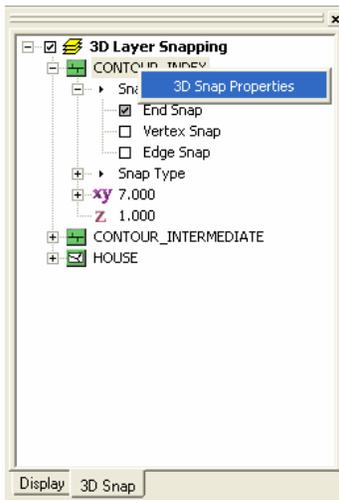
The Stereo Analyst Options property sheet provides a property page for definition of the Vertical Coordinate System. At ArcGIS 9.2, the ArcMap Document does not support the concept of Vertical Coordinate Systems.



Finally, a sample coordinate system transformation is reported. The coordinates for this sample transformation are taken from the oriented image footprint and projected into the horizontal and vertical coordinate system currently defined for the ArcMap Document.

Enhancements to 3D Snap Tools

The following enhancements have been made to the 3D Feature Snap Tools in Stereo Analyst for ArcGIS 9.2.



Snap Properties Context Menu (or double click).

- Snapping performance improvement through implementation of a user configurable spatially indexed feature cache.
- Enhanced user interface for controlling 3D Snap Properties including:
 - Layer Property Page for controlling 3D Snap properties
 - Tree view control enhancement for global enable/disable of all 3D Snap Agents
 - Right click contents view menu (and Double Click) access to 3D Snap Property Page.
 - Commands that toggle snap types (End, Edge & Vertex) that are assignable to a 3D Pointing device such as the TopoMouse.

3D Snap Performance Improvement

Snapping in ArcGIS - "Under the hood"

Snapping in ArcGIS is implemented through software components known as Snap Agents. When using the ArcMap Editor's Edit Sketch or Edit Tool to move vertices of an existing Edit Sketch, each movement of the pointing device results in a call to each of the active Snap Agents (potentially one for each feature class in the map document) to determine if a feature is within the Snap Tolerance. As soon as one of the Snap Agents reports a snap, the Editor's Snap Cursor (a circular object that normally follows the cursor while editing) will jump to the feature that has registered the snap.

Snap Agents accept the XY location of the Editors cursor and assess features that are within proximity (Snap Tolerance). The Features that are assessed come from an in-memory cache that is maintained about the cursor location. The in-memory cache is required because performing a spatial query each time would cause an unacceptable degradation in performance.

The management of the compromise between cache size and number of features served to the Snap Agents is a performance critical issue. This compromise may be described as follows:

- The Feature Cache needs to be kept small in extent to keep the number of snap candidate features to a minimum so that Snap Agent performance (and therefore cursor responsiveness) does not degrade
- The Feature Cache extent cannot be so small that each time the cursor moves, it is refreshed. Frequent refreshing of the Feature Cache will also cause a performance degrade
- The Feature Cache cannot be so large that each time it is refreshed, a noticeable delay occurs while features are loaded.

The potential performance degradation that can be caused by incorrectly configured Snap Feature Cache manifests itself in the user interface as a “sticky” or “jumpy” cursor. A degraded Snap Agent performance problem will cause the Snap Cursor (circle) to lag behind the movement of the cursor and in extreme cases, the Snap Cursor could completely disappear from the display for several seconds at a time.

In order to manage the performance of the Feature Cache it is necessary to allow the cache parameters to be tuned to suit the characteristics of each individual feature class in the Edit Workspace.

Indexed Feature Cache Solution

The solution to this problem is to operate with a feature cursor that has a larger extent resulting in fewer refresh events in conjunction with a spatial index that helps to minimize the features served to the Snap Agents for assessment. The extra cost of loading the cache is balanced against the improved performance gained through serving fewer features to the snap agents. As such, Stereo Analyst for ArcGIS 9.2 has undergone a significant 3D Snap performance enhancement through the implementation of a user configurable indexed Feature Cache.

There are two user configurable properties for the 3D Snap Feature Cache, they are Cache Size as a percentage of the map document, and Spatial Index grid order. By default the cache size is set to 33% of the Map Documents extent (re-assessed each time the cache is refreshed) and the Spatial Index Tile Order defaults to 2 – meaning that the feature cache is divided into $2 \times 2 = 4$ square indexing tiles.

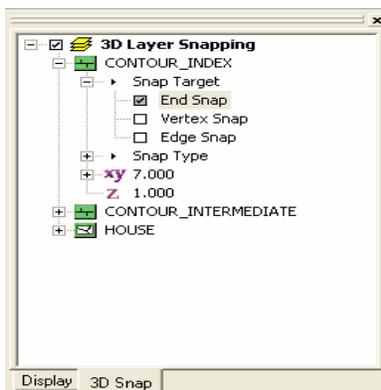
Importance of Database Tuning

When using Enterprise or Personal Geodatabases, it is particularly important that the spatial index configuration for the feature layer be tuned for optimal Snap Agent performance. Each time the Feature Cache is refreshed, a spatial query is applied to the Feature Class. If the spatial index parameters configured for the feature class are not optimally configured, Snap Agent performance will degrade.

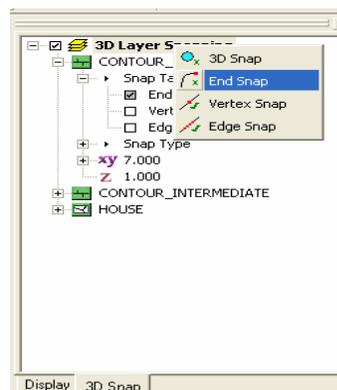
3D Snap User Interface Enhancements

3D Snap Tab Content Changes

The 3D Snap tab Contents View has been extended to include a check-box to allow global toggling of the 3-D Snap Agents. This item also has a right click context menu that provides access to commands that toggle individual elements of the 3D Snap properties (for details refer to Snap Toggle Commands below).



New Global Snap Toggle



Right click context menu

New Snap Type Toggle Commands

Four new commands have been added under the category of “Stereo 3D Snapping” available from the customization dialog.



These new commands allow the operator to globally toggle any or all of the following:

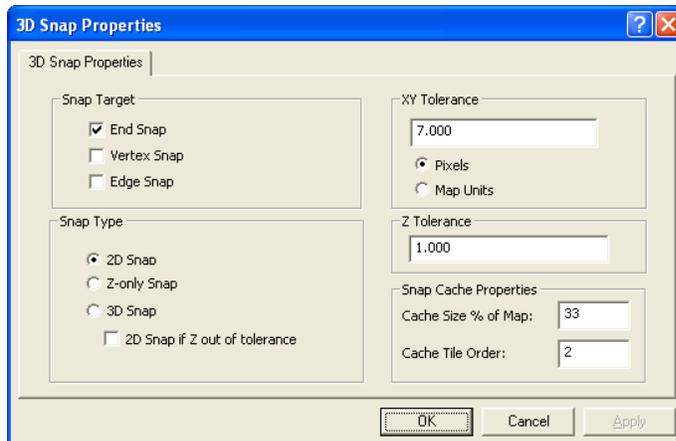
- 3D Snap Agents
- End Snap
- Vertex Snap
- Edge Snap

These commands may be accessed by any of the following means:

- Right click context menu from the 3D Snap tab Contents View “3D Layer Snapping” item
- Placing the commands on a toolbar
- Direct assignment to TopoMouse buttons (default).

3D Snap Property Page

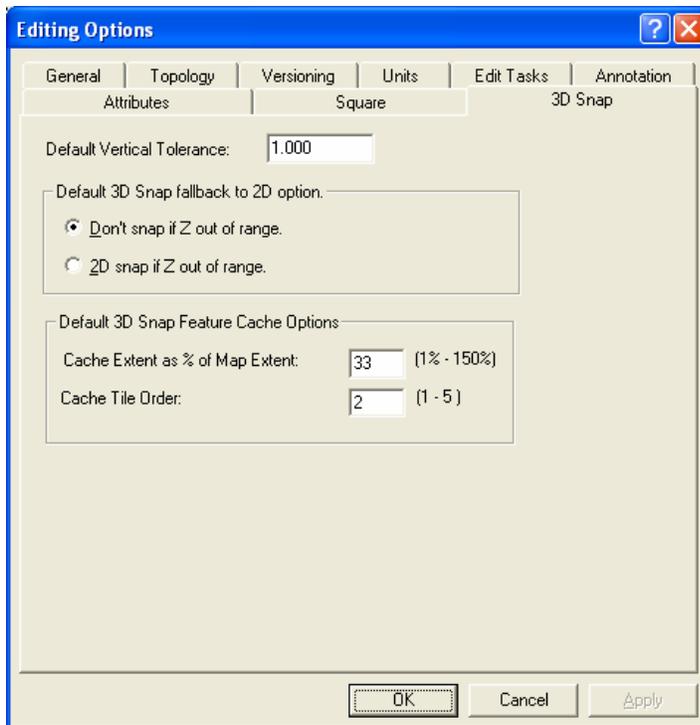
The new 3D Snap property page provides an alternate means of altering 3D Snap Agent properties for individual layers. The property page for a Snap Agent may be accessed directly from the 3D Snap tab Contents View or from the Layer Properties Sheet.



3D Snap Properties

3D Snap Editor Property Page

The 3D Snap Editor Properties page is available from the editor toolbar options dialog. This page has been enhanced to allow specification of default startup options for 3D Snap Properties associated with the 3D Snap Agents. When a new feature dataset is added to ArcMap, the new 3D Snap Agent will obtain its startup properties from the existing horizontal snap properties as well as those set by this property page. The properties controlled by this page are persisted in the MXD document.



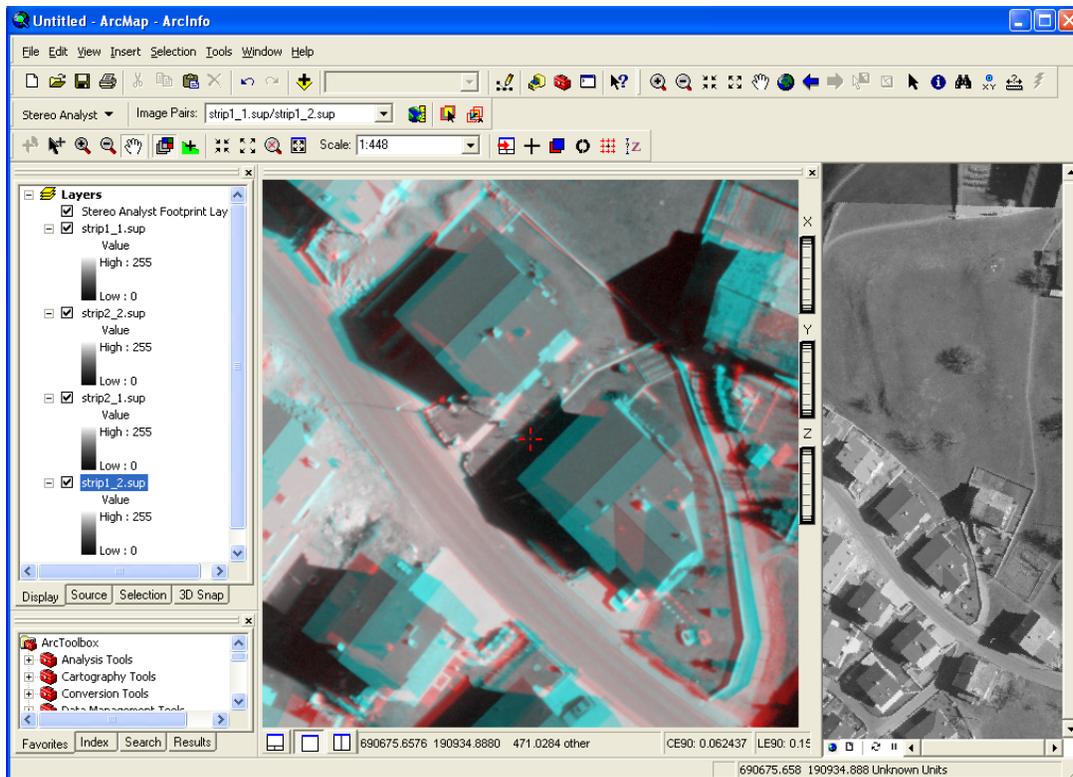
3D Snap defaults from ArcMap's Editor toolbar options

Enhanced SOCET SET Support

Support for SOCET SET photogrammetry projects has undergone a significant update:

- | | |
|--------------------|---|
| Coordinate Systems | LSR coordinate systems map to ESRI's new Local Coordinate System. In addition, Geographic Coordinate Systems in SOCET SET projects are now fully supported without the need for SOCET SET to be installed. |
| Project Files | SOCET SET Project Files may be added directly to the ArcMap Document (either by the Add Data button or by Drag 'n Drop). If added to a new ArcMap Document, the Spatial Reference of the project file will be adopted by the ArcMap Document. Otherwise the individual SUP file Spatial Reference will be used to re-project the imagery into the ArcMap Documents spatial reference. |
| Sup files | SOCET SET Support files are now recognized as a raster format and may be directly added to the ArcMap Document.

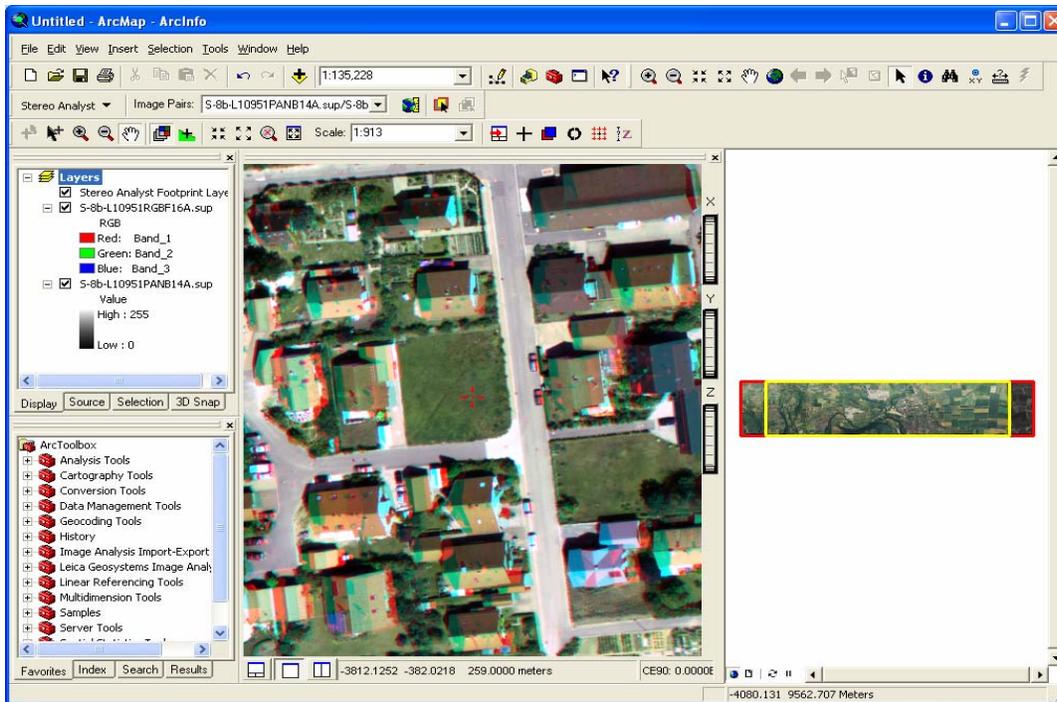
Note: If the paths to the images are incorrect in the SUP file, you will get an error message on loading. After repair, the images will come in without error. |



ArcMap now supports direct loading of SUP files.

ADS40 Support

Level 1 ADS40 Imagery is now supported by Stereo Analyst for ArcGIS. Support files representing ADS40 stereo pairs may be added directly to ArcMap or the data can be imported from an LPS block file or SOCET SET project file. Updated Map Projection support in the Coordinate System Objects means that the LSR coordinate systems defined inside the ADS40 SUP files will be re-projected into the ArcMap Document's Spatial Reference.



ADS40 Imagery in ArcMap Document as well as the Stereo Window.

Improved Terrain Following Cursor Feedback

A new option has been added to the 3D Floating Cursor Tab from Stereo Analyst Options to allow the specification of different stereo cursor characteristics for when the terrain following cursor (or Snap to Ground command) is successfully placed on the terrain. This enhancement will help to reduce excessive eye movements previously required to ascertain if the cursor placement on terrain was successful.

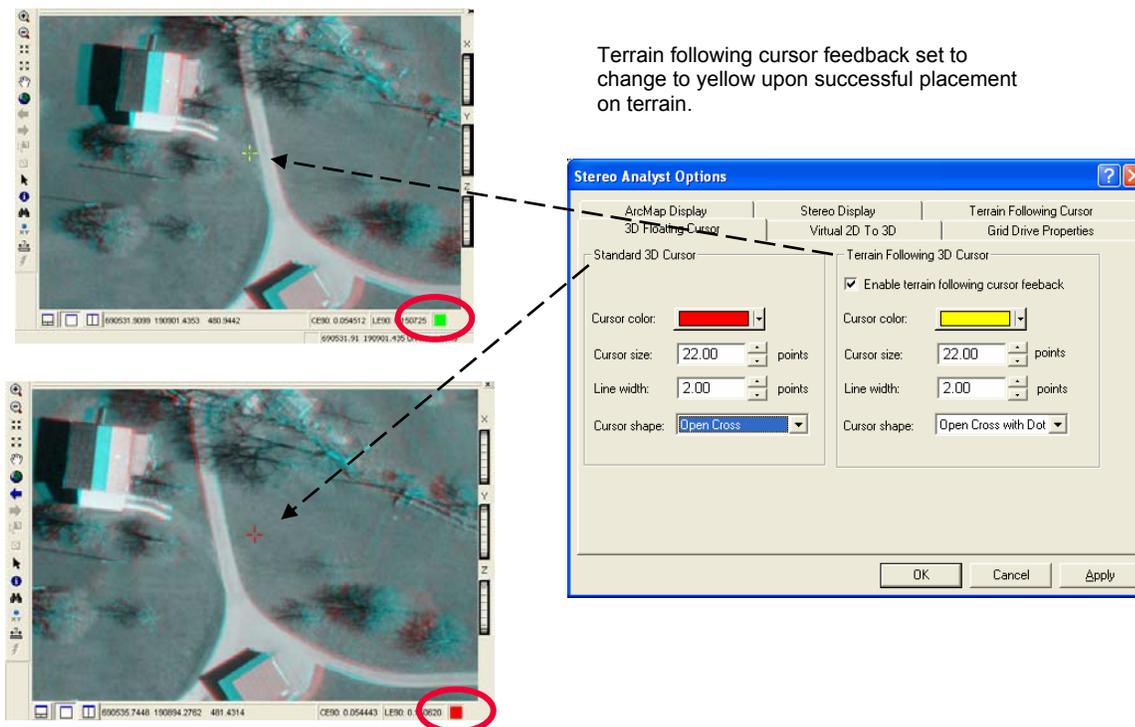


Image Analysis for ArcGIS

All processing functions in Image Analysis for ArcGIS are now geoprocessing tools available from ArcToolbox. The only exceptions are the seed and georeferencing tools which require on-screen user interaction.

All user interface dialogs available from the standard Image Analysis toolbar have been replaced with the geoprocessing versions of the user interface dialogs. This allows options for processing to be set within the processing dialog itself via the environments button instead of requiring users to set process specific actions up in the Options dialog prior to selecting the function tool. Below is an example of the Mosaic dialog launched from the Image Analysis toolbar. If data is loaded in the ArcMap document when this tool is selected, it will populate the input images section of the dialog automatically in the same order as the data in the ArcMap document.

