

## Analyze 6.0: New Features and Enhancements

**The Insight ToolKit (ITK):** The Insight ToolKit (ITK) is an open-source toolkit of advanced filter, segmentation and registration algorithms contributed by leading scientists and institutions around the world under sponsorship by the National Library of Medicine as part of their Visible Human Project. ITK is seamlessly integrated into Analyze 6.0 (and AVW 6.0) to provide to researchers the powerful functionality of ITK via a set of interactive Analyze modules. ITK functionality has been integrated into the Analyze/AVW environment at two levels. First, key ITK filter, segmentation and registrations functions are wrapped as AVW functions, making them directly accessible to AVW developers using the same API as for AVW function calls. Second, custom Analyze modules are now available from the main Analyze menu to interactively run the ITK algorithms. These new Analyze modules include:

**ITK Filter Module:** Adds both linear and non-linear filters to the collection of spatial filters offered in Analyze. These filters can be used for smoothing, gradient calculation, and feature extraction via distance transforms or edge detection. Specific filters include: bilateral, binary min/max curvature flow, binomial blur, B-spline decomposition, curvature anisotropic, curvature flow, Danielsson distance, derivative, discrete gaussian, anisotropic gradient, gradient magnitude, recursive gaussian gradient magnitude, min/max curvature flow, and zero crossing edge detection.

**ITK Segment Module:** Provides an interactive framework for applying sequential processing steps using ITK functions for segmentation of sets of 2-D slices based on region growing and level set methods. Filtering steps can be applied to preprocess the images, including anisotropic diffusion and flow filters, along with either gradient magnitude or recursive gaussian edge detection. Seed-based techniques can then be selected for target structure definition, including seeded region growing, fuzzy connectedness, a fast marching algorithm and watershed region extraction. Further mask-based algorithms can be applied, including shape detection techniques, active contour definition, and Canny or Laplacian edge extraction. Standard morphological operators can be applied to the segmented regions to further refine the segmentation, including erode, dilate, open, close, and connected component analysis.

**ITK Seg 3D Module:** Implements all of the functionality of the previous module in a full 3D volume image segmentation context. Each algorithm is extended to apply to the entire 3D volume image for full 3D segmentation using region growing and level set methods, with associated pre- and post-processing algorithms.

**ITK Registration Module:** Using the interactive multipanel registration interface developed for other Analyze registration modules, the ITK registration module implements the mutual information-based ITK registration algorithm for multimodal 3D volume image registration and fusion.

**Macintosh (MacOS X) compatible:** The Analyze 6.0 release is the first version of Analyze available on the Mac platform. This port of Analyze runs with MacOS X 10.3 and uses the native Mac interface (via Tcl/Tk) as the standard user interface for Analyze on the Mac. This port is still a beta release, as there are remaining Tcl/Tk-based issues that have yet to be handled by the Tcl/Tk community on the Mac platform.

**Continued enhancement to DICOM image support:** including the following:

Improved selection of closest orthogonal orientation from the direction cosine information in the DICOM header.

Support added for 24-bit RGB run length encoded (RLE compressed) images stored in DICOM format.

All lossless JPEG transfer syntaxes are now supported.

Robust handling of images that contain sequence information.

**Load/Load As enhancements:** including the following:

If the maximum and minimum values in the header for the volume image being loaded are equal, a prompt is offered to calculate the true max/min during loading or set these to specific values.

Clicking the right mouse button over the Input Maximum or Input Minimum fields in the Intensities panel will provide an option to Calculate Max/Min for the volume being loaded.

Loading of multivolume image files in non-transverse (sagittal/coronal) orientations is now supported.

**Import/Export enhancements:** The Volume Tool and the associated volume wrapper file format now supports the inclusion of individual 3D volume image files to form 4D data sets.

**Multiplanar Sections enhancements:** The Scan Tool contains a new feature to interactively report the voxel coordinate and value at the position of the cursor in the image display window.

**Oblique Sections enhancements:** Smoother, predictable transitions in oblique images are now computed for obliques generated along a traced curve (following a trace generated by Curved Sections). This keeps sections from flipping and/or rotating significantly as they are generated along the curve.

**Volume Render enhancements:** A new tool called the Fix Tool has been added to the Manipulate tools in Volume Render. This tool allows a variety of correction methods for missing or corrupt images that occur in a volume, including removing corrupt images, copying from an adjacent uncorrupted image, and interpolation from a range of uncorrupted images near the corrupt image.

**Region Of Interest (ROI) enhancements:** including the following:

A new tool called Propagate Regions has been added to the Tools menu to permit shape-based interpolation of objects (region sets) throughout the volume. The main purpose for this tool is to allow sparse definition of region sets throughout the volume (i.e., every other slice) that can then be interpolated into complete 3D regions (objects) using shape-based interpolation.

Additional support has been added to allow multivolumes to be used as the Related Volume, with controls for linked volume selection between the original and related volumes or independent volume selection for these multivolumes.

**Brain Atlas enhancements:** The Brain Atlas module now supports the use of object maps associated with the volume image being registered atlas. This permits the transformation of an object map associated with the input volume into the Brain Atlas registration space, providing both the transformed volume image and the transformed object map as outputs for further use.