

3D DOCTOR

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I. INTRODUCTION

3D-DOCTOR is an advanced 3D modelling, image processing and measurement software for MRI, CT, PET, microscopy, scientific, and industrial imaging applications. 3D-DOCTOR supports both greyscale and color images stored in DICOM, TIFF, Interfile, GIF, JPEG, PNG, BMP, PGM, MRC, RAW or other image file formats. 3D-DOCTOR creates 3D surface models and volume rendering from 2D cross-section images in real time on your PC. You can export the polygonal mesh models to STL (ASCII and Binary), DXF, IGES, 3DS, OBJ, VRML, PLY, XYZ and other formats for surgical planning, simulation, quantitative analysis, finite element analysis (FEA) and rapid prototyping applications. You can calculate 3D volume and make other 3D measurements for quantitative analysis. 3D-DOCTOR's vector-based tools support easy image data handling, measurement, and analysis. 3D CT/MRI images can be re-sliced easily along an arbitrary axis. Multi-modality images can be registered to create image fusions. Misaligned slices can be automatically or semi-automatically aligned using 3D-DOCTOR's image alignment functions. Other image processing functions include template-based film cropping, image re-slicing to correct slices of uneven thickness, volume resizing, and image rotation. The 3DBasic scripting tool makes it easy to create Basic-like sophisticated 3D imaging programs. 3D-DOCTOR is cleared by FDA (US Food and Drug Administration 510K clearance) for medical imaging and 3D visualization applications. 3D-DOCTOR's user interface is similar to other Windows software programs. You can use the menu items or toolbars to start the processing commands. You can use the keyboard to scroll an image display window up, down, left, and right, and to rotate a 3D display to different angles. You can use the mouse to draw a selection rectangle within an image window or perform data editing functions. The right mouse button is used to bring up a floating pop-up menu with available editing options when in an editing mode.

3D-DOCTOR has 5 main types of display windows:

- Single IMAGE PLANE VIEW to show a single image slice at a time.
- MONTAGE VIEW to display all slices from a 3D image. The view can display the slices in a mosaic form, or a single slice as a side profile or top profile view.
- VOLUME VIEW to display volume rendered images.
- SURFACE VIEW to display 3D surface models.
- PLOT WINDOW to display histograms and measurements.

Each window has its own set of commands to open and save files, edit, and process data associated with the display window. You can click the left mouse button within a window to make it active.

II. MINIMUM SYSTEM REQUIREMENTS

Operating Systems: Windows XP, Vista, 7 or newer version. Other operating systems, including Macintosh and Unix, are not currently supported.

CPU: Pentium, Pentium compatible or better

RAM: A minimum of 128 MB is required, although 512 MB or more is highly recommended to provide better performance for processing larger images.

HARD DISK: 50 MB are needed for the software and additional space is needed to store your 3D images.

DISPLAY: At least a 16-bit color or better display with OpenGL support. This normally requires setting up your Display using the device driver provided by the video board manufacturer. Use the Start/Settings/Control Panel option or right mouse click on the PC screen and then use the Properties/Settings option to set up or change the display settings.

Terminology

Many imaging terms have been used by 3D-DOCTOR. Some are standard image processing terms and some are 3D-DOCTOR specific.

The best way to understand the terms and commands is to work with the software.

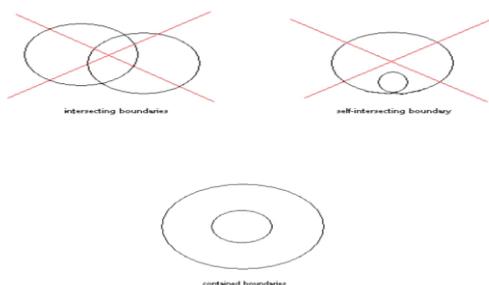
2D Image/Image Slice/Image Plane: A single slice of an image is a 2D image. One slice of a volume image can be called a 2D image. For example, when you scan a film and save the scanned image to a TIFF or JPEG file, it's a 2D image.

When you open a 2D image (single slice) in 3D-DOCTOR, you only see the IMAGE PLANE WINDOW that displays the single image and no MONTAGE

WINDOW.

3D Image/Volume Image: A 3D volume image includes a stack of 2D images. A 3D volume image can be stored in a single image file or multiple files where each file contains one image slice or plane. In 3D-DOCTOR, when a 3D image is opened, you will see two display windows. The IMAGE PLANE WINDOW shows a single slice with full details, and the MONTAGE WINDOW shows all of the image slices within the 3D image. You can simply open the image to see if it is properly organized as a 3D image or still a single 2D slice. In 3D-DOCTOR, the File/New Stack command is used

to put single image slices together to form a 3D image for processing and analysis. Calibration: For a 3D image, the Voxel size (image resolution) must be provided to 3D-DOCTOR. This ensures that the 3D rendered image will have the correct scale in all 3-dimensions and result in calibrated computation for all the reporting functions. Calibration parameters for voxel resolution include the size of a pixel in a slice, for example, 1 mm, and the slice thickness. The slice thickness is the sum of the image slice thickness plus the gap distance between two neighbour slices. For DICOM images, these parameters are normally provided in the header, but you may need to adjust the slice thickness if not all the slices are used. Calibration parameters for voxel values can also be entered and used by reporting and quantitative analysis functions when available. Object: In 3D-DOCTOR, an object contains the boundaries and the image pixel data within the boundaries. When a boundary is drawn, it always belongs to the current object. For example, a 3D image of a head can be separated into multiple objects, including the outline of the head, the skull, and the brain. Once boundaries are generated for every single object, the boundaries can be used for 3D rendering. You can set objects together to create different 3D displays by turning them on or off. For example, if half of a head and the brain are selected as objects, an image of an exposed brain will appear with the half of the head that was selected. Objects are defined and updated using the Edit/Object Setting command. Boundary/Contour: Boundaries are contours that define the area of a 3D object in each slice within a 3D image. Because boundaries are used to tell which part of the volume image is included in 3D rendering and quantitative analysis, they are required before 3D rendering can be done. On each image plane, one object can have any number of boundaries that are not self-intersected or intersected to each other. One boundary can be contained by another boundary of the same object to form a hole or island (See Figure on the next page). The polarity rule applies in boundary topology to indicate which part is included and which part is excluded. For example, when a voxel is first contained by a boundary, it is included. The second time it is contained by a boundary of the same object, it is outside the object or excluded. The third time it is contained by a boundary of the same object, it is included again. Boundaries can be generated automatically using the Auto Segment, 3D Rendering/Interactive Segment or the 3D Rendering/Segment Object command. You can manually define or update boundaries using the Edit/Boundary Editor command. Boundary data can also be imported from other digitizing devices and ASCII files.



Region of Interest (ROI): User defined regions of interest (ROI) are used to limit the image areas to be processed by the image segmentation functions. After an image is open, ROIs are defined using the Edit/Regions of Interest command before segmentation is done for an object. ROIs can be in several shapes or combinations of shapes, such as polygons, circles, and rectangles. ROIs defined using Edit/Regions of Interest apply to all image slices and new ROIs may need to be defined when segmenting other slices. If you already have a boundary for an object and would like to use the boundary as a temporary ROI for segmenting a new object within it, then use the Edit/Regions of Interest/ROI by Boundaries command to create an ROI from the existing object boundaries. The existing object must be set as "Current" before you do this.

Segmentation: Segmentation is an automated image processing function to extract or generate object boundaries. 3D-DOCTOR has several image segmentation functions. For example, the 3D Rendering/Interactive Segment function uses the image's greyscale range to create boundaries. The 3D Rendering/Segment Object function uses a defined training area to help detect similar image regions. The segmentation function can process all slices automatically.

Surface Rendering: Surface rendering creates polygon-based 3D surface models from defined object boundaries. It displays the surface model and allows you to change the color and transparency properties of the rendered objects. 3D volume and surface area can be accurately calculated from these surface models. You can save surface models to 3D formats such as AutoCAD DXF and IGES. Saving a surface model in VRML format allows for use over the Internet by web browsers with the necessary plug-ins. In addition, 3DS format can be used for 3D Studio and STL format can be used for rapid prototyping applications. The WAVE FRONT OBJ and raw surface triangles allow the transfer of data to other software packages.

Volume Rendering: Volume rendering creates a 3D display using both the 3D image and the boundaries. Voxels are ray-traced to show the image in a 3D space. Volume rendering supports several rendering modes, including transparency, where voxels are treated as transparent, direct object, where only surface voxels are displayed, and maximum density, where only the brightest voxel is displayed along each ray. Because volume rendering creates each view by ray-tracing the entire volume, it may take a longer amount of time to rotate when you have a larger image. For 3D volume rendering, you can save the data to a XYZ file, where each voxel location is recorded as a point.

III. 3D-DOCTOR MAIN FUNCTIONS

The following is a list of things you can do with 3D-DOCTOR:

Visualize Images In Most File Formats: DICOM, TIFF, BMP, JPEG, Interfile, PNG, Raw Image Data, and other 3D image formats are all supported in 3D-DOCTOR. Image files in various vendor specific formats can be easily imported using 3D-DOCTOR's universal image import function. 3D surface rendering data can be exported to AutoCAD DXF, IGES, STL for rapid prototyping, VRML for Internet use,

3DS for 3D Studio, and WAVE FRONT OBJ and raw triangle objects to transfer 3D surface model to other programs. 3D volume rendering data can be saved as volume, or as 3D XYZ format. The 3D XYZ format is compatible with many commercial 3D quantitative analysis and simulation programs.

Process Most Image Types: 3D-DOCTOR can process 8-bit and 16-bit gray scale images, 8-bit and 24-bit color images, and 1-bit black and white images. Image type conversion functions are provided to change image types. For example, converting a 24-bit RGB color image to greyscale, or converting a 16-bit greyscale image to an 8-bit gray scale image reduces the size of the image.

Template Based Film Cropping: If your CT or MRI images come on film, then you can scan them using a film scanner or a regular image scanner with a transparency kit for 3D processing. 3D-DOCTOR's template based Image/Crop Image/Crop Film command can be used to crop image slices, and save them to image files automatically.

Powerful Display Functions: A 3D image is displayed in both an IMAGE PLANE WINDOW to show full details of a single image plane/slice and a MONTAGE WINDOW where all image planes are displayed as thumbnail size panes to allow easy navigation between slices. The 3D volume rendering and 3D surface rendering allows you to see the image in 3D. By using move creation function, all display windows can be animated and saved to an AVI movie file. You can switch the image plane display to another slice by double clicking on a pane in the MONTAGE WINDOW. With the palette control functions, you can change the palette to pseudo color, red, green or blue. You can adjust the image contrast to enhance the image display, or apply log scale or square root scale functions to the image histogram to give stronger contrast to a certain range of pixel values. In addition, you can display images with or without pixel interpolation.

3D Image Segmentation to Generate Object Boundaries: Before you create a surface or volume rendering for a 3D image, use one of the segmentation commands to extract object boundaries. Multiple objects are supported so you can visualize single objects or a combination of many objects in 3D.

3D Surface Rendering to Create 3D Surface Models: From boundary data, 3D surface models are created using the surface rendering functions. The display settings such as color and transparency can be adjusted interactively within the 3D SURFACE WINDOW using the View/Object command. You can export the models to formats such as DXF, IGES, STL, VRML, and 3DS. 3D volume and surface area can be calculated from the surface rendered models.

3D Volume Rendering: The ray-tracing based volume rendering provides several display modes: opaque or transparent voxels in color or greyscale.

Boundary Data Editing and Processing: You can define or update object boundaries using the Boundary Editor. Boundaries can be processed using functions under the Edit/Boundary Process sub menu, such as smooth, split object, delete by length, delete by image planes, and other functions. A detailed report for boundary data can be

generated easily using the Boundary Report function for quantitative analysis.

Editors for Image, Point Markers, and Annotation : The Image Editor allows pixel value editing, displaying, and mapping to other values. Point markers are used to mark locations in a 3D image and are controlled using the Point Editor. Annotations are easily created using the Annotation Editor.

Image Measurements: Area, surface area, volume, distance, profile, and an image region histogram can all be calculated in 3D-DOCTOR. With the Measuring Tool, you can quickly measure the length, area of a region, image density in a region, and view the pixel histogram.

3D Image Re slicing: With a single command, you can re slice a 3D image along the X-axis, Y-axis, or an arbitrary axis defined by a 3D angle. Re-sliced images allow you to make more accurate measurement or examination of certain objects that have different orientations.

3D Image Registration, Auto Alignment, and Fusion: Easily register two images that are related by specifying 4 or more control points in 3D-DOCTOR. Once a pair of images are registered, you can create an image fusion by combining the two images in any of the methods supported, including add (+), subtract (-), And, OR, transparent, Max, Min, etc. If you have two images from a single source, for example, a CT image and an MRI image for the same patient, using the registration and fusion functions, you can create a brand new image with information you could never visualize before.

3D Volume Image Reconstruction: Create parallel cross-section, volume images using x-ray images taken at angles around the object. This allows you to turn your x-ray machine into a full CT (Computed Tomography) system using 3D-DOCTOR.

3D Image Restoration by Deconvolution: 3D-DOCTOR provides two highly efficient deconvolution methods for 3D image restoration and reconstruction, a fast nearest neighbour algorithm and an iterative maximum entropy algorithm. If you have a 3D image acquired from a device where the point spread function (PSF) is known, then you can easily get a restored image with much higher quality using 3D-DOCTOR's restoration functions.

3DBasic: Scripting support makes it easy to combine 3D-DOCTOR functions for complicated batch mode processing and software customization. 3DBasic is easy to learn because it uses standard Basic-like syntax and provides full support for flow control and different types of variables.

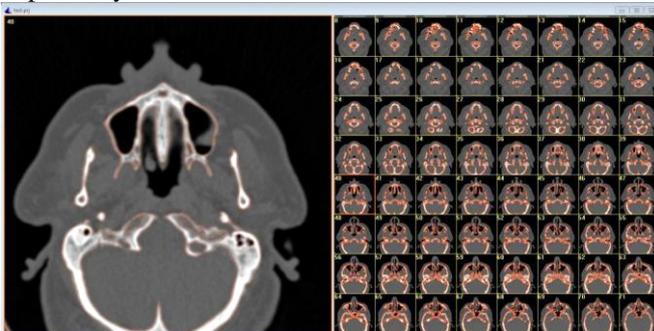
User Interface

3D-DOCTOR software has a similar user interface as other Windows programs. It includes several types of windows to display a 2D image plane (IMAGE PLANE WINDOW), 2D image panes organized as a montage (MONTAGE WINDOW), 3D volume images (VOLUME VIEW WINDOW), 3D surface images (3D SURFACE WINDOW), and 1D curves in a PLOT WINDOW. 3D-DOCTOR uses menu bars, tool buttons, floating pop-up menus, a mouse, and keyboard commands to interact between the user and the software. The on-line help provides information on commands and options implemented in 3D-DOCTOR. The

menu options can be selected with either a mouse or with keyboard shortcuts.

IV. IMAGE PLANE WINDOW AND MONTAGE WINDOW

A 3D image consists of a number of 2D image planes or slices. When a 3D image is opened by 3D-DOCTOR, two display windows are created: the IMAGE PLANE WINDOW and the MONTAGE WINDOW. If the image is initially displayed only in the IMAGE PLANE WINDOW, it indicates the image has only a single slice and you may need to use the File/New Stack command to put multiple slices together into a 3D image for processing. After the stack list is created, you can use it directly to open the 3D image. Once you have boundaries and other data, you can save all data to a project file. A project file contains all processed data, such as objects, boundaries, point markers, annotations, and the file path to the image file. Image data itself is not saved in the project file. When you move your project file to a new location, make sure the image file is moved as well. The IMAGE PLANE WINDOW displays one image plane at a time with the plane ID displayed at the top left corner of the window. The IMAGE PLANE WINDOW is the main display and analysis window for a 3D image, where all image processing functions, editing functions, measurement tools, and segmentation functions are used. Function keys F5 and F6 move the display to the previous slice or next slice, respectively.



The MONTAGE WINDOW displays all image planes that are organized sequentially in one window. Each image plane is displayed as a pane with a plane ID in a MONTAGE WINDOW. Double clicking in an image pane within the MONTAGE WINDOW will display the selected image plane in the IMAGE PLANE WINDOW. The MONTAGE WINDOW provides a navigation tool among the 3D image planes and an overview of the 3D image structure.

Note in 3D-DOCTOR, we count image planes starting from 0. If a 3D image has 256 planes or slices, the first plane is plane 0 and the last plane is plane 255.

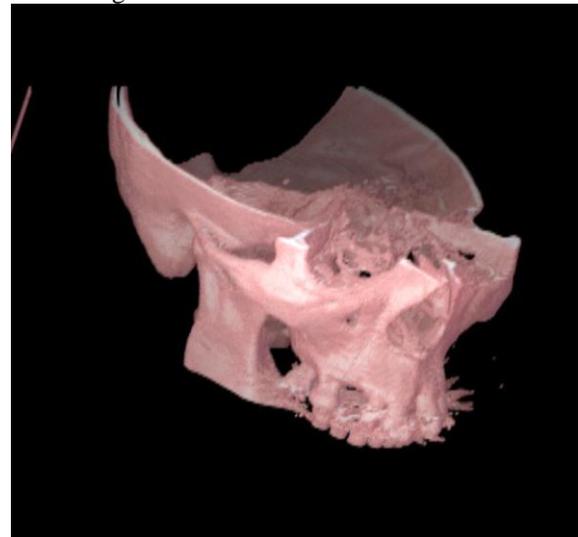
3D-DOCTOR generated data, such as boundary lines, point markers, annotations, and control points are displayed in the IMAGE PLANE WINDOW and are edited here as well. Some data items may be displayed in both the IMAGE PLANE WINDOW and MONTAGE WINDOW, but editing always takes place in the IMAGE PLANE WINDOW.

All functions under the View menu can be used to control the display of the IMAGE PLANE WINDOW, including zoom in, zoom out, pseudo color palette selection, image contrast adjustment, interpolation mode, and histogram enhancement.

When the IMAGE PLANE WINDOW is in the zooming mode (scroll bars will be displayed), the ARROW KEYS, PAGE UP and PAGE DOWN, HOME, and END keys can be used to scroll the image. To zoom into a specific image region, you can hold down the left mouse button and drag it to draw a select rectangle and then press the F2 key to zoom in. The F3 key zooms out.

V. VOLUME VIEW WINDOW

3D volume renderings are displayed in a VOLUME VIEW WINDOW. The 3D rendered image is created using ray-tracing algorithms and displayed at different user selected angles. The display can be animated along a certain viewing angle using the View/Animate command. The screen image can be saved to an image file in TIFF format using the File/Save Image As command.



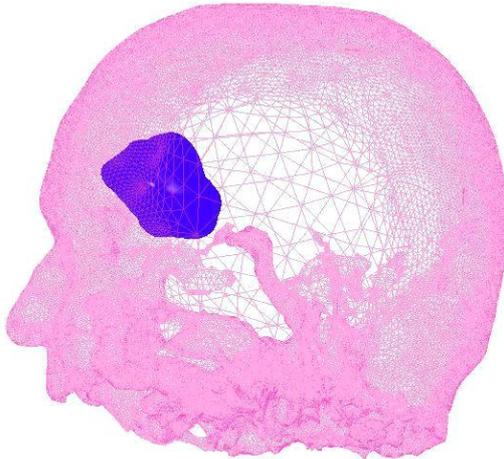
If no object boundary has been defined, you can draw a selection rectangle in the IMAGE PLANE WINDOW and use the 3D Rendering/Cube Boundary command to define boundaries for a cube volume and then perform Volume Rendering. When boundaries are defined, volume rendering can be used directly. You can use 3D Rendering/Split Object to slice object boundaries into 2 parts and then use the split object for volume rendering. The 3D volume can be saved to XYZ, or 3D-DOCTOR's own VOL file formats.

The VOLUME VIEW WINDOW has a set of display control functions in the View menu to zoom in, zoom out, use pseudo color palette, and adjust contrast and other display controls.

VI. 3D SURFACE WINDOW

3D surface models created by surface rendering functions are displayed in the 3D SURFACE WINDOW. The 3D surface models are in 3D polygon mesh form, represented by surface triangles and polygons. The models can be viewed from any

selected angle and can be animated along a certain viewing path. The data created by surface rendering methods can be saved to a vector-based 3D graphics file format, such as DXF format, to be used by other 3D modelling or graphics software packages. The data can also be saved in STL format for rapid prototyping applications, or in VRML format for display through the Internet.



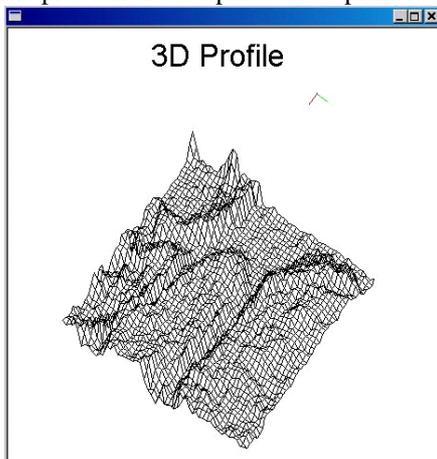
The 3D SURFACE WINDOW has its own set of display control functions, including zoom in, zoom out, viewing angle adjustment, light source control, animation, and the use of different surface rendering methods. The View/Object command within the 3D SURFACE WINDOW is used to toggle an object display on and off, change the color, and its transparency mode.

3D volume and surface area can be calculated from surface models using the Tools/Calculate Volumes command within the 3D SURFACE WINDOW.

VII. PLOT WINDOW

One-dimensional curves such as image pixel profiles, image histograms, and 3D image pixel profiles generated using the Edit/Measuring Tools commands are displayed in a PLOT WINDOW.

The PLOT WINDOW allows the display of multiple lines. The data can be saved to an ASCII text file in table form, which can be used in a spreadsheet or other data analysis program. The plot can also be printed to a printer.



The 3D image profile generated from the Edit/Measuring Tool/3D Profile command is

Displayed in a 3D PROFILE WINDOW (See Figure). The plot can be printed to a printer or saved to a text file.

Menu Bar

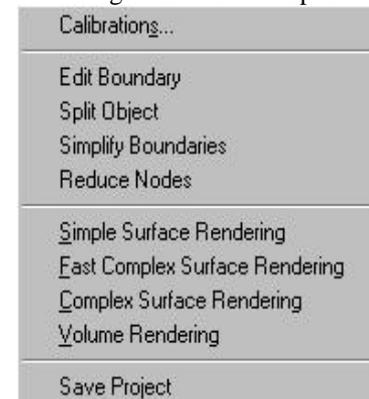


The menu bar provides the access to 3D-DOCTOR's processing commands. Each type of display window has its own menu bar. Some functions are common to all windows, such as the print and help commands. Some functions are specific to a certain type of image window and their availability depends on the current image type and processing status. An image window must be activated to make its functions accessible. When you have multiple windows, you can click the left mouse button within a window to make it active.

Most of the options provided by Edit/Boundary Editor, Edit/Point Editor, and Edit/Control Point Editor can also be invoked from the floating pop-up menus. Clicking the right mouse button within the IMAGE PLANE WINDOW brings up the floating pop-up menu with some popular commands or editing options.

You can display a menu's option by clicking on its menu heading with the left mouse button, or by holding down the ALT key and typing the underline letter of its menu heading. You can also select a menu option with the function keys, called hot keys, for example, F1 to get on-line help, F2 to zoom in and F3 to zoom out. F5 and F6 set the current display to the previous or next image slice, respectively.

Some menu options initiate commands directly, while others include a floating pop-up menu brought up using the right mouse button or use a dialogue box to initiate commands. An ellipsis mark (...) next to a menu heading indicates that there is a dialogue box for that option.



In 3D-DOCTOR, all options under the editing tools can be invoked using either the main drop down menu or the floating pop-up menu brought up by clicking the right mouse button within the IMAGE PLANE WINDOW.

The Floating Pop-up Menu

To select an option using the floating pop-up menu while in an editing mode, first use the right mouse button to bring up the pop-up menu and then use the left mouse button to select the option.

The Mouse



A two-button mouse lets you position the cursor and select items on the screen.

The left mouse button is normally used to select menu options, edit screen objects, and draw a selection rectangle for zooming in and out.

Click the right mouse button to display a floating pop-up menu that provides the most frequently used commands, depending on the processing status and the current data type.



The Keyboard

The keyboard can be used to start commands and enter text, such as file names and annotations.

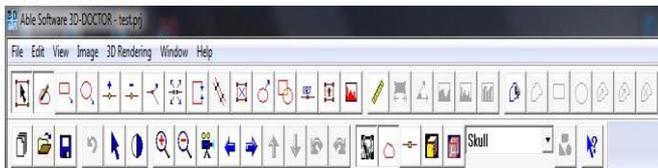
The keyboard is also used with some editing tools, for example, the Boundary Editor and Measuring Tool. When drawing a boundary polygon for an object boundary or region of interest, hit the SPACE BAR to close the boundary and finish the current polygon.

Some short cut keys are also enabled for specific functions, for example, F1 for help, F2 for zoom in, and F3 for zoom out. When in the Zoom In mode, use the ARROW keys, PAGE UP, and PAGE DOWN keys to scroll in the IMAGE PLANE WINDOW.

When a 3D image is displayed, you can use F5 to go to the previous image plane and F6 to go to the next image plane.

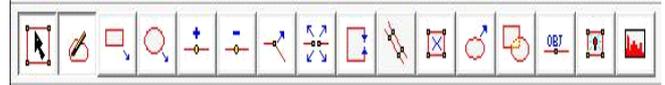
For the 3D SURFACE WINDOW and the VOLUME VIEW WINDOW, use the ARROW keys to rotate the 3D display.

Toolbars

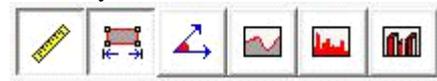


At the top of the IMAGE PLANE WINDOW, toolbars provide access to the more frequently used functions, such as view controls, editing tools, and other functions. If your cursor stops on a tool button for a few seconds, a simple tool tip will appear to show you the command.

Turning on the specific editing mode can activate the toolbars.



Boundary Editor toolbars



Measuring Tool toolbars



Region of Interest (ROI) Tool toolbars



Zooming and Rotating toolbars



Object List and Object Setting toolbar. The drop down list allows you to quickly select one object and set it as “current”.

VIII. 3D-DOCTOR WORK FLOW

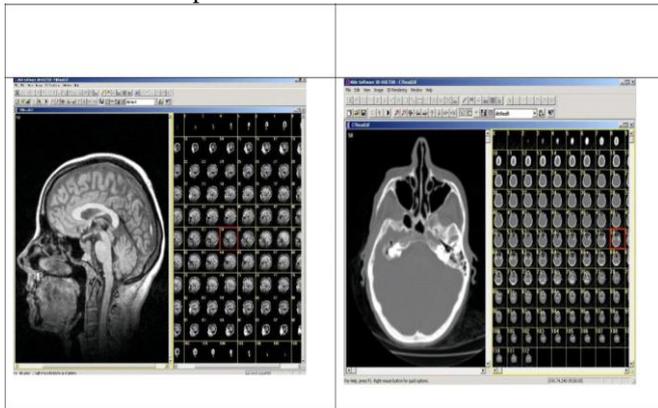
3D-DOCTOR is developed using object-oriented technologies that make the software highly efficient to process and manipulate 3D images and other associated data items in an integrated environment.

- **Open Image File:** Use the File/New Stack command to put multiple slice image files into a 3D stack or the File/Open command if multiple slices are stored in a single image file. Your image can also be processed using the commands under the Image menu.
- **Define Object and Object Boundaries:** Use the Edit/Object Settings to add objects to your project. Use the 3D Rendering/Auto Segment to automatically detect object boundaries. You can also use the Interactive Segment or Segment Object commands to generate object boundaries for the defined objects. You can use Edit/Boundary Editor to trace object boundaries manually.
- **3D Surface Rendering and Volume Rendering:** You can export the 3D surface models using the File/Export Model command to many commonly used formats and create advanced animation using the View/Animation Control command.

Register Image command (Image Menu)

This command is used to interactively register the current image against a target image by adjusting the orientation, location and scale. The current image and the target image

should have multiple slices.

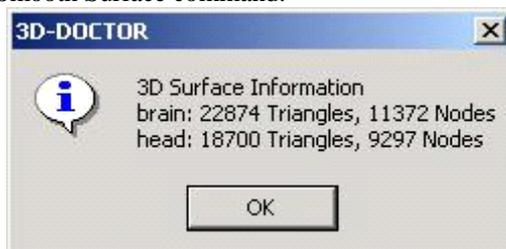


If you want to adjust the orientation and scale of your current image, you can use it as the target image and repeat the above steps. For example, you can re slice the image using this command.

Surface Info...command

This command shows the number of face triangles and nodes for all currently rendered objects. When the Tools/Surface Info command is selected, a 3D-DOCTOR dialog box appears with the surface information (See Figure)

The number of triangles and nodes can be reduced using the Tools/Smooth Surface command.



Measure and Measure Report commands

This command switches on and off the 3D measurement tool and allows measuring length between points on a 3D surface. To make a measurement, first change the orientation of a 3D surface model using the arrow keys so the region to be measured is visible. Move the cursor to a location and click the left mouse button to pick a location. A point marker is displayed at the location. Repeat this step to pick more points. The 3D coordinates of the current point and the cumulative length is displayed in the status bar at the bottom of the window.

When you have entered all points for the measurement, use the Measure Report command to display the results.

You can use the "ESC" (Escape) key or the "Clear Measure" command to clear the current measurement curve before starting another measurement.

Viewing Angle Commands

Viewing angle can be adjusted using the mouse. Hold down

the left mouse button and move to rotate the object. The mouse wheel is used to zoom in and out. Hold down the right mouse button to move the object within the display window.

Turn Right...command (Viewing Angle sub menu)

Use this command to turn the current 3D object to the right.

Turn Left...command (Viewing Angle sub menu)

Use this command to turn the current 3D object to the left.

Turn Up...command (Viewing Angle sub menu)

Use this command to turn the current 3D object up.

Turn Down...command (Viewing Angle sub menu)

Use this command to turn the current 3D object down.

Turn CW...command (Viewing Angle sub menu)

Use this command to rotate the current 3D object clockwise.

Turn CCW...command (Viewing Angle sub menu)

Use this command to rotate the current 3D object counter clockwise.

Setting...command (Viewing Angle sub menu)

When the View/Viewing Angle/Setting command is selected, a 3D Display Setting dialogue box appears.

This dialogue box allows you to interactively change the viewing angle of your 3D surface model.

IX. CONCLUSION

3D-DOCTOR Software has been one of the tremendous analysis software that is used to extract information from image files to create 3D model. It provides engineering teams more accurate analysis for internal human parts and also creates visual models for complex blood vessels such as coronary artery, aorta, and superficial femoral artery (SFA) in a much faster turnaround time. With 3D-DOCTOR, we can quickly load up image files, sort out the anatomy, and present a 3D model to the project team to see first-hand the anatomy before making the next decision to choose a case and help analyze the case before creating visual models for device deployment / testing in the lab.

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