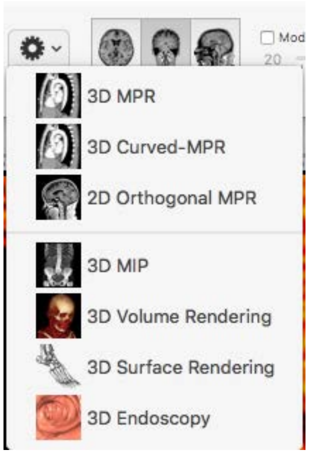


Figure 6.11. The dropdown list for the 2D/3D button.

3D MPR

You can use the 3D Multi-Planar Reconstruction to adjust the image volume in three oblique planes. Each plane can be tilted individually using the vertical and horizontal lines in each Image Window (Figure 6.12). For example, hovering the mouse cursor over one of these lines reveals two curved arrows indicating that you can rotate this line. As you rotate one line in one image view the other two images will adjust accordingly. Alternatively, if you use the cursor to gram the intersection of the two lines, the cursor becomes hand and you can move it right or left and up and down. As before, the other windows adjust accordingly (Figure 6.13).

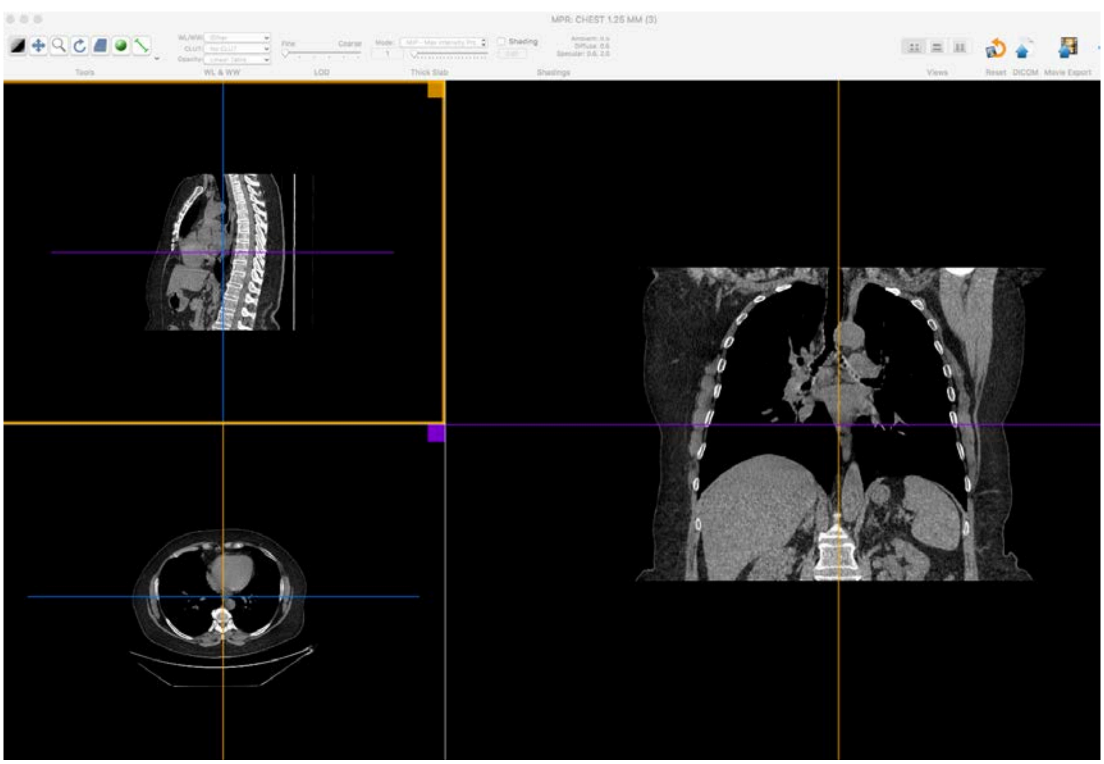


Figure 6.12. The MPR view showing three image windows (Axial, Coronal and Sagittal) and the horizontal and vertical position lines in each image.

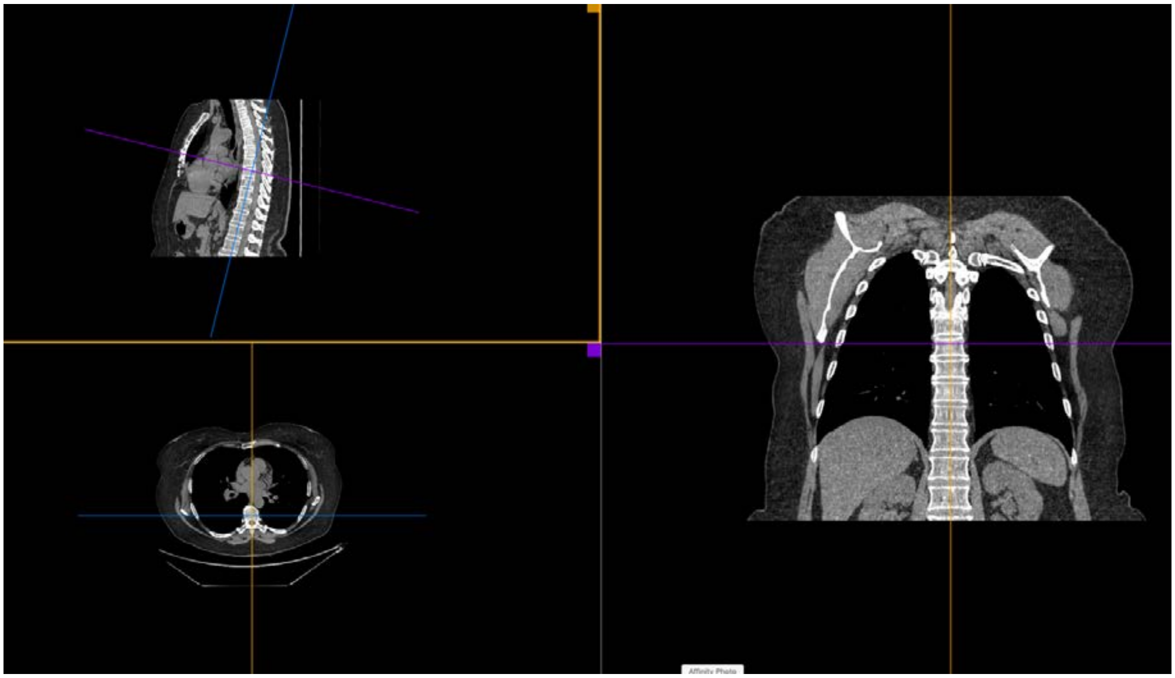


Figure 6.13. Here the image in the upper left has been tilted along the spinal cord. Notice That the two other images are repositioned accordingly.

3D Curved-MPR

You can use the 3D Curved MPR to display a curved section across the body or along an anatomical structure.

2D Orthogonal MPR

You can reformat and display the image volume along the 3 orthogonal planes (Axial, Coronal and Sagittal) as shown in Figure 6.14.

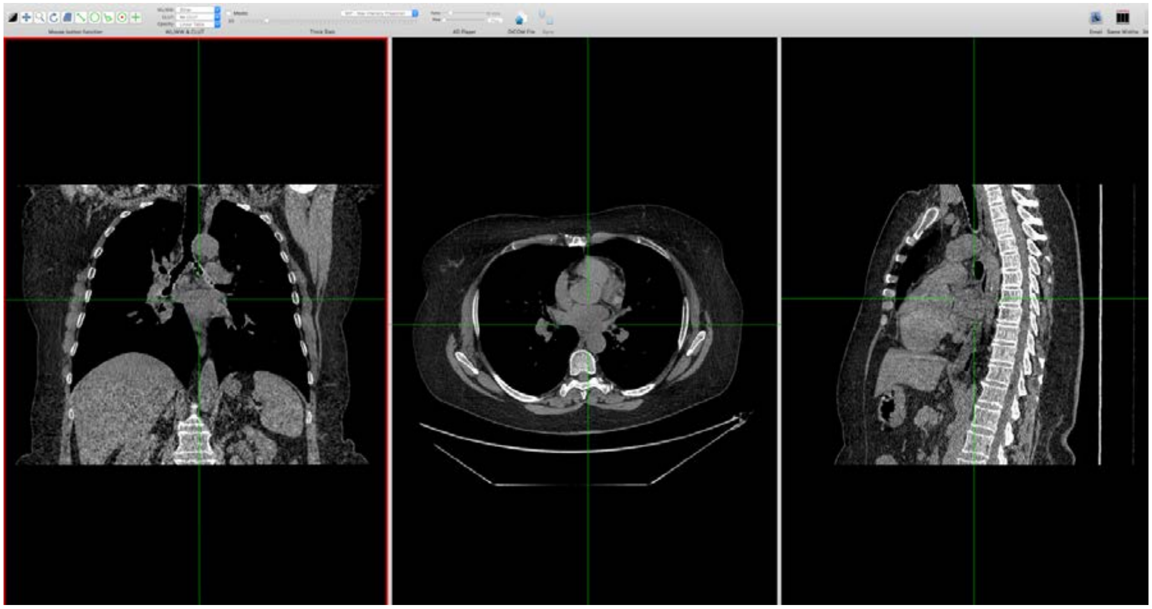


Figure 6.14. Three orthogonal planes as depicted in the 2D Orthogonal MPR.

The 3D tools listed below are described in greater detail in Chapter 7.

3D MIP

MIP stands for ***Maximum Intensity Projection***. It is a volume rendering technique that analyzes several consecutive sections (slices of a CT, for example) of a volume and projects the voxel (three dimensional pixel) with the maximum intensity. Imagine a cube with 10 voxels per side. See Chapter 7 for additional detail.

3D Volume Rendering

Volume Rendering technique creates as RGBA volume from the data and projects it as a 2D view. The RGB are the traditional red, green, blue colors and the A represents opacity. Here an opacity of 1 is totally opaque and an opacity of 0 is totally transparent. The volume is then projected on a opaque background (typically black). See Chapter 7.

3D Surface Rendering

Surface rendering is a 3D technique uses only part of the 3D data to reconstruct an image. Typically, the data used to reconstruct the image is defined by a threshold. Voxels with a value below the threshold are discarded, and voxels with a threshold value equal to or greater than the threshold will be rendered (Figure 6.15).

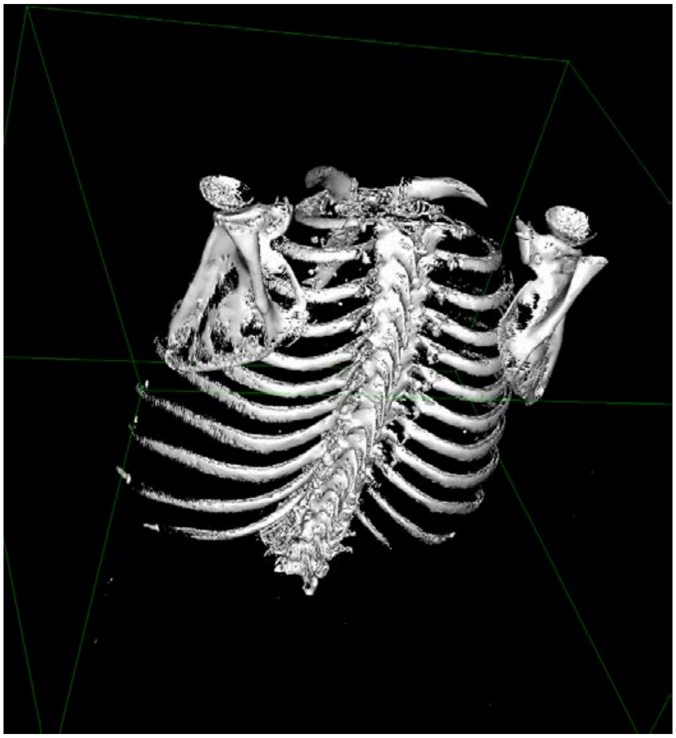


Figure 6.15. A 3D surface render of the image in Figure 6.14 using a threshold value greater than 200.

3D Endoscopy

This advanced rendering technique is used for interactive navigation of hollow organs, including colon, blood vessels and airways in the lungs.

Orientation

You can quickly move between axial, coronal, and sagittal image stacks using the orientation buttons (Figure 6.16). An example of each is shown in Figure 6.17.

Figure 6.16. The orientation buttons in the 2D Viewer Menu.

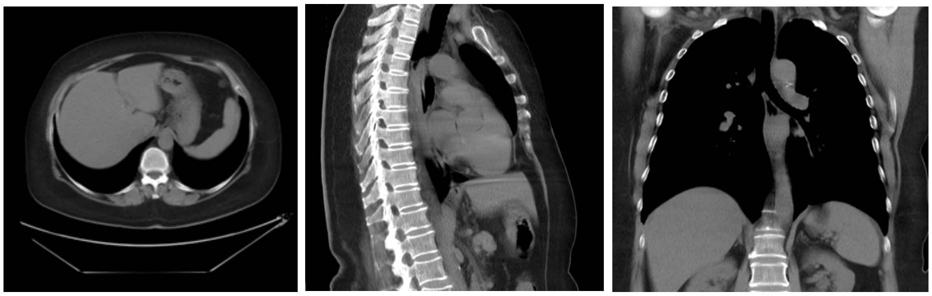


Figure 6.17. Left – axial image. Middle – Sagittal image. Right – Coronal image.

Thick Slab

Horos uses stacks of images to present 3D data. Typically, a single image represents one image in the stack and its thickness is determined at the time the patient was scanned. For example the images in Figure 6.17 are each 1.25mm thick. However, Horos also allows you to manually adjust the thickness (using different algorithms) using the Thick Slab slider in the tool bar (Figure 6.18). You can set the size of the slab (i.e. the number of images) and the algorithm to use when creating the new image.

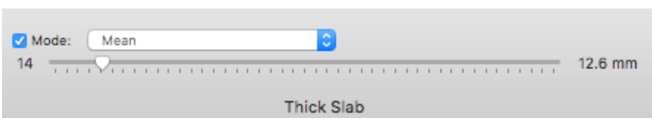
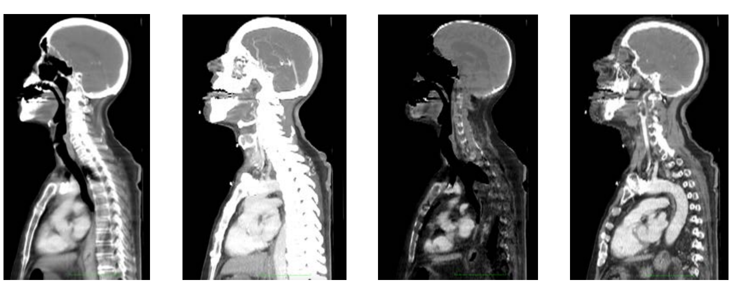


Figure 6.18. The Thick Slab slider in the Horos menu bar.

There are five rendering modes in the Mode dropdown menu. They are Mean, MIP, MinIP and Volume Rendering (two modes). For example, the Mean mode uses an algorithm that computes the average of each pixel at the same location and displays the mean pixel in the resulting image. The MIP mode stands for Maximum Intensity Projection. It displays the pixel in the thick slab stack with the maximum intensity. Conversely, the MinIP displays the pixel with the minimum intensity at that location in the slab.

The Volume Rendering algorithm will display a 3D representation of the thick slab images. Examples of each display are shown in Figure 6.19.



Mean. *MIP* *MinIP* *Volume Rendering*

Figure 6.19: The 4 Thick Slab Algorithms with thick slab set at 35.

The final group of tools on the default tool bar is shown in Figure 6.20.

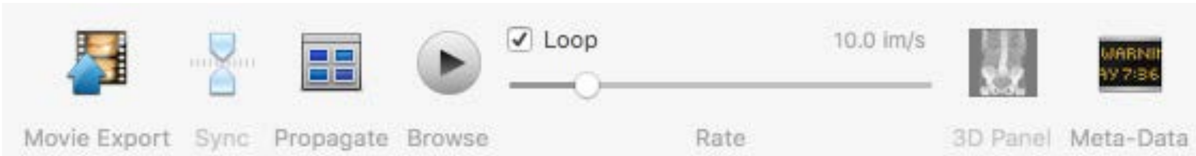


Figure 6.20. The right most panel of tools in the default display.

Movie Export

You can export a movie clip of the DICOM series by clicking on the Movie Export button. A popup screen is displayed that allows you to set such parameters as number of frames, starting frame, interval, and so on. If you are in sagittal view the movie will run through the sagittal series stack. This function is also available in the File > Export menu by selecting Export to Movie.

Sync

You can turn stack synchronization on and off using the Sync button.

Propagate

You can turn the settings propagation on and off using the Propagate button. This feature is also found in the Horos menu by clicking 2D Viewer > Propagate Settings Between Series.

Browse

The Browse button starts displaying the stack as if you were scrolling through the stack. The rate at which images are displayed is et with the Rate slider. If you click the Loop box the scrolling will continue to loop from beginning to end and back again.

Rate

As described above in the Browse tool, the Rate slider allows you to change the speed at which images are displayed.

3D Panel

By clicking on the 3D Panel button you create a small floating window that displays a 3D MIP of the currently series.

Meta-Data

You can display the Meta-Data associated with this DICOM image next to the image by clicking the Meta-Data button as shown in Figure 6.21.

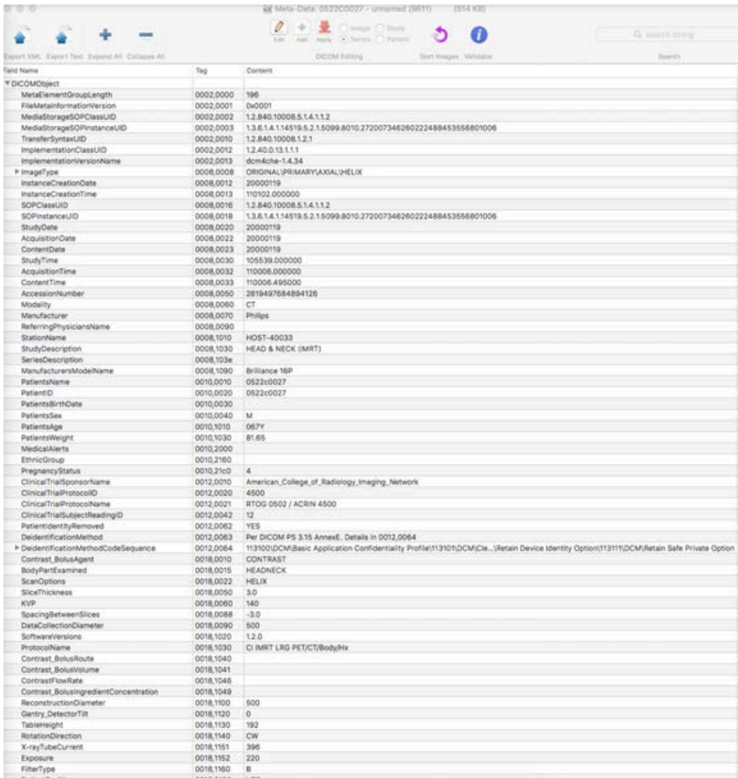


Figure 6.21. The Meta-Data display widow.

Additional Tools

In addition to the default tool bar displayed by Horos users can customize the tool bar by adding and removing tools. The additional tools are available from the Format > Customize Toobar in the top menu. This brings up a window with all available tools listed. The non-default tools are described below in alphabetical order.

3D Position

When viewing two datasets simultaneously, you may notice the two image stacks are not well aligned. You can manually adjust the image registration between two modalities (PET–CT for example) using the 3D Position tool (Figure 6.22). This tool displaces the overlaid images in the up, down, left and right directions and in the axial, coronal and sagittal planes. You can move the image, by clicking on the arrows or clicking and holding the thumbnail icon in the middle. This item is also available as an icon in the 2D Viewer and the 2D Orthogonal MPR toolbar.

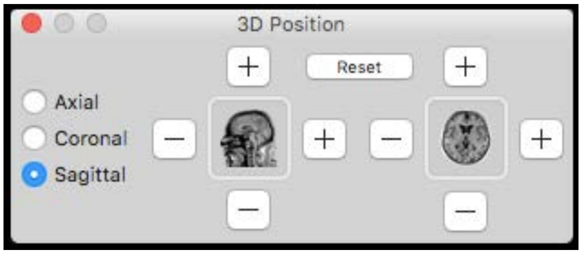


Figure 6.22. The 3D Position tool popup window.

4D Player

A 4D series contains multiple series with the same dimensions (matrix size) and the same number of images. For example, a 4D MRI of the heart might have 20 series of 512 × 512 images, with movement as the 4th dimension. Such a 4D dataset allows you to visualize blood flow to assess symptoms of aneurysm or valve disease. If you are using a 4D dataset, the 4D Player tool allows you to scroll through the 4th dimension. You can adjust the rate slider to set the number of images/sec and the Position slider to set the start point and then click Play.

Cobb's Angle

You can use this button computer the angle of Cobb. The Cobb angle is the angle formed between a line drawn parallel to the superior surface of a vertebra above a fracture or spine deformity and a second line drawn parallel to the inferior surface of a vertebra below the fracture (Figure 6.23). Using the Cobb's Angle tool you can select one line (it will be highlighted in yellow) and display the angle in the second line's info box (Figure 6.24). This tool can also be found in the ROI tab on the main Horos menu.

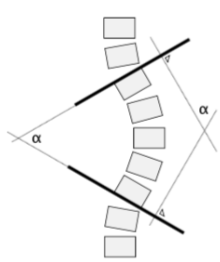


Figure 6.23: The angle of Cobb (represented by α).

Figure 6.24. An example of Cobb's Angle displayed on a sagittal section of the human spine.

Convolution Filters

You can apply various convolution filters in real-time, using the Convolution Filters dropdown list (Figure 6.25). These filters are also available in the 2D Viewer menu. The details for each filter are described later in this chapter.

Figure 6.25. The drop down list of available convolution filters.

Email

You can export the current image or all the images in the series as an email message (Figure 6.26). You can also export the current image to your Photos library ans set the image format as JPEG or TIFF.

Figure 6.26. The Email tool popup window.

Export as DICOM File

You can export the current image or the entire series as DICOM files by using this tool. Tool displays a pop up window (Figure 6.27) with several options. You can choose an image format (8 bit RGB, 16 bit BW or stored in memory in 16 bit BW. Clicking on the All images of the series button activates the interval slides in the middle of the pop up window. Changing the interval and the range reduces the number of images to be exported. At the bottom of the window, you can enter a name for the series you want to export.

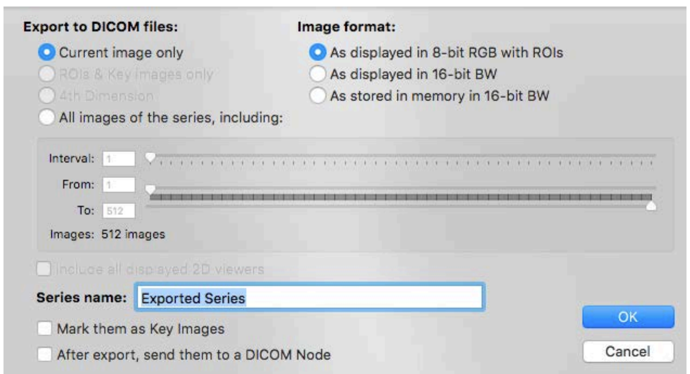


Figure 6.27. The Export as DICOM File popup window.

Flip

You can invert the order of images in a series using the Flip tool. The first image becomes the last image and vice versa. This function is also available in the 2D Viewer Menu: Flip Series.

Flip Horizontal

You can flip the image horizontally using this tool. For example, an image with the patient facing right is flipped so that the patient is now facing left on the screen. The orientation annotations displayed on the image are also correctly modified: right and left annotations will be flipped. This function is also available in the 2D Viewer Menu under Orientation.

Flip Vertical

This tool flips the image vertically. For example, an image with the patient's head at the top is flipped so that the patient's head is now facing down on the screen. The annotations displayed on