

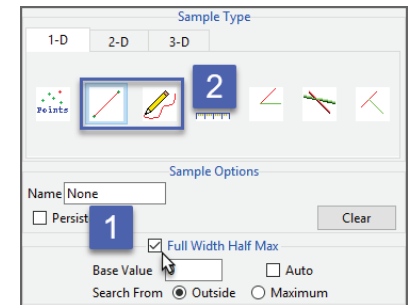


Sample Line(s)

The Sample Line(s) tool allows users to define a line on a 2D image or a 3D rendering. The tool will report distance measurements, line intensity profile and the coordinates of the line end points. The following configuration options are available:

Sample Options: Provides users with access to the following line sampling options:

- **Name:** Allows users to assign a name to the defined lines when reported to the log file.
- **Persistent:** When selected prevents previously defined lines for being cleared from the image.
- **Clear:** Clears all lines from the image.



Full Width Half Max: The Full Width Half Max (FWHM) option can be enabled [1] for the Sample Line(s) and Sample Trace(s) tool [2].

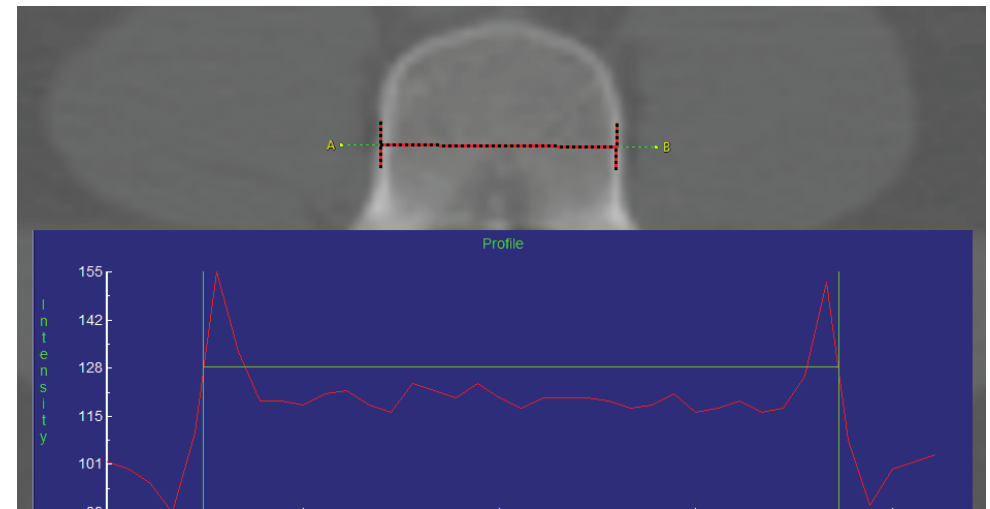
Once enabled, Measure will automatically log FWHM distance measurements [3] for defined lines [4] and traces.



Sample Line(s) Options (continued)

Full Width Half Max (continued):

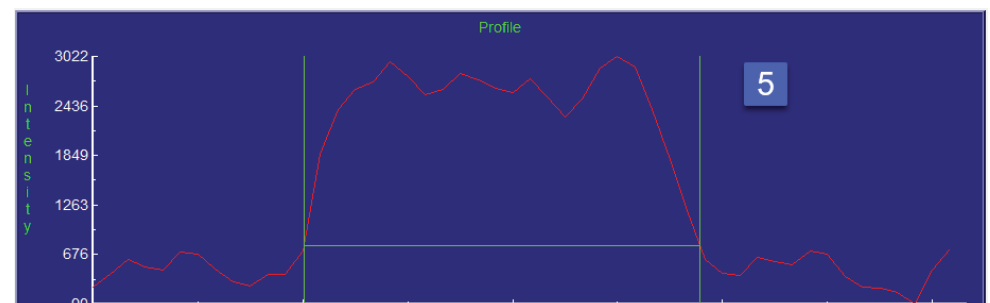
- **Base Value:** Allows users to specify the value used in the FWHM calculation.
- **Auto:** When enabled, the base value is automatically calculated by computing the mean of the nine-point neighborhoods around each endpoint of the line or trace
- **Search from:** Allows users to specify the search mode for FWHM measurement. The following options are available:
 - **Outside:** Specifies that search begins at the ends of the profiles.
 - **Maximum:** Specifies that search begins at the maximum value and proceeds to both the left and right for the two half max values.



The Full Width Half Max

To find the FWHM of the line profile [5] (the calculation of pixel intensities along straight lines and freehand traces on the images), the 'Half Max' value is first computed using the formula:

$$\text{Half Max} = ((\text{Maximum Value} - \text{Base Value})/2 + \text{Base Value})$$





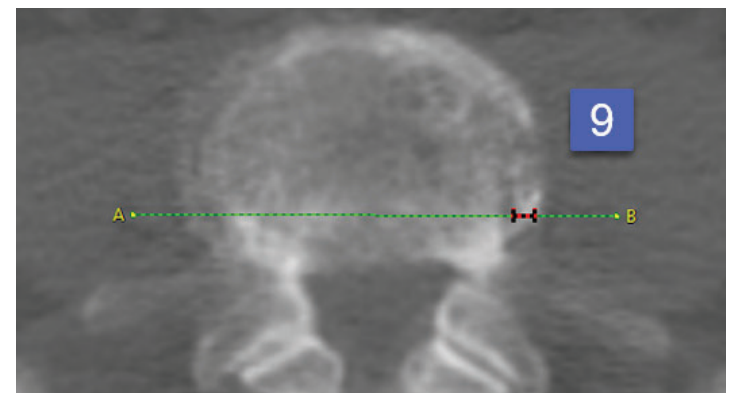
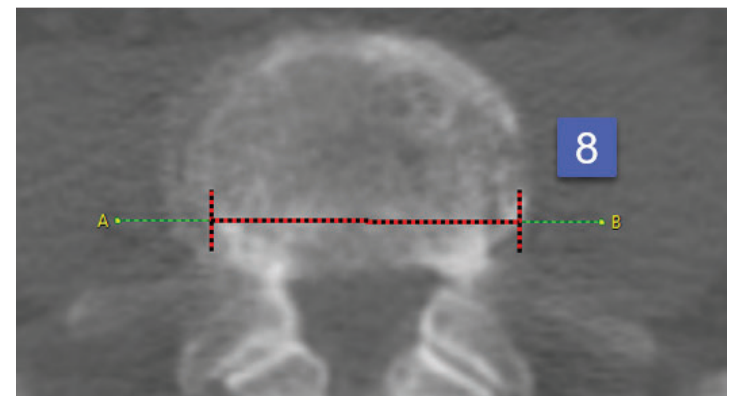
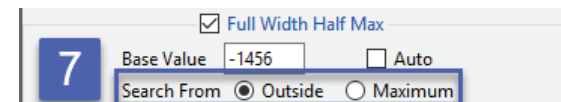
Sample Line(s) Options (continued)

Full Width Half Max (continued):

The 'Maximum Value' is the maximum intensity value of the line profile. The 'Base Value' is defined under the Full Width Half Max options [6]. The Base Value can be set to a specified value, or it can be set dynamically using the 'Auto' option. When the Auto option is selected, the Base Value is set to the mean intensity value of the nine-point neighborhoods surrounding each endpoint of the line. Once the Half Max value is known, Measure will search the line profile to see where that value is first crossed over on either side of the line maximum. The direction from which the module searches the line profile for the Half Max is determined by the 'Search From' option in under the Full Width Half Max options [7].

If the Search From option is set to 'Outside', then Measure will search for where the line intensity values cross over the Half Max value beginning at the outside of the profile and moving inwards. In this example, the FWHM will be defined by the closest voxel to either endpoint of the line with an intensity value greater than the Half Max value [8].

If Search From is set to 'Maximum', then Measure will search for where the line intensity values cross over the Half Max value beginning at the profile Maximum and moving outwards (to the right and left). In this example, the FWHM ends up being defined by the voxels closest to the line Maximum that have an intensity value less than the Half Max [9]. Once the FWHM of the line has been defined, Measure will compute the FWHM distance by taking the distance between the voxels on either side of the FWHM weighted by their relative value to the true Half Max value.





Sample Line(s) Options (continued)

Stats to View

General: Allows reporting of general data parameters in the stats log file. See Sample Point(s) > Stats to View > General for full description.

DICOM Info: Allows reporting of DICOM tag information. See Sample Point(s) > Stats to View > DICOM Info for full description.

Line Traces:

- **Orient:** Reports the orientation the line was defined in. Options include; Axial, Coronal, Sagittal, Rendering, and Oblique.
- **Name:** Reports the name.
- **End Point Locations:** Reports the X, Y, Z location of each line end point (A and B).
- **Maximum:** Reports the maximum voxel intensity value along the line.
- **Minimum:** Reports the minimum voxel intensity value along the line.
- **Mean:** Reports the mean intensity value for the voxels along the line.
- **Standard Deviation:** Reports the standard deviation.
- **Endpoint Distance:** The Endpoint Distance (or Distance as reports in the stats display) reports the linear distance from end point A to end point B. Note, even if this option is unchecked it will still be reported to the stats display area and stats log.
- **Curved Distance:** Reports the curvilinear distance between the endpoints. The curvilinear distance is an approximation based on the distance between the two 3-D surface endpoints.
- **Surface Distance:** The Surface Distance is only available for lines defined on the rendering. This option reports the surface distance of the line. The defined line is projected onto surface of the rendering and measured.
- **Profile:** Displays the line profile plot.

FWHM:

- **Half Max:** Reports the half max intensity value.
- **Half Max Location:** Reports the X, Y, Z location of both half max locations.
- **Maximum:** Reports the maximum voxel intensity value along the line.
- **Base Value:** Reports the Base Value.
- **Distance:** Reports the FWHM distance.



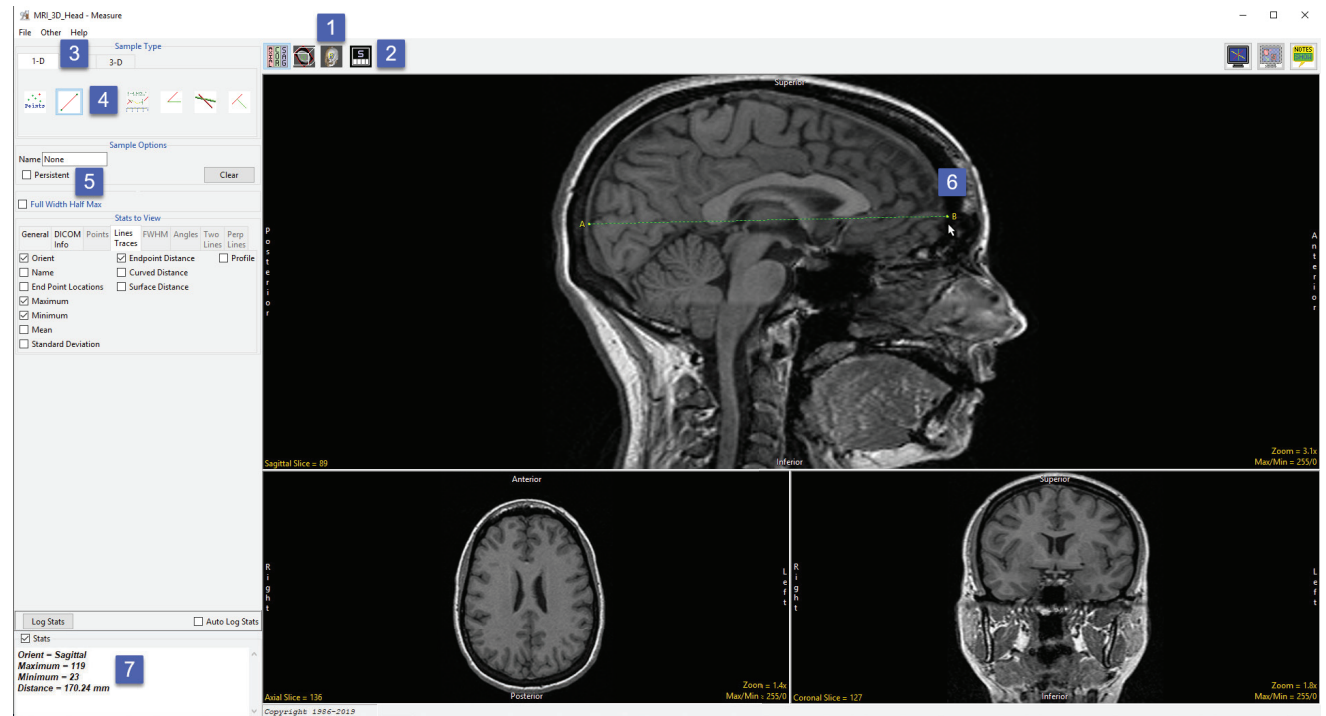
Making Line Measurements using Sample Line(s)

Here we use the Sample Line(s) tool to make line measurements.

Download the MRI_3D_Head.avw data set from analyzedirect.com/data to follow along.

To make a line measurement, do the following:

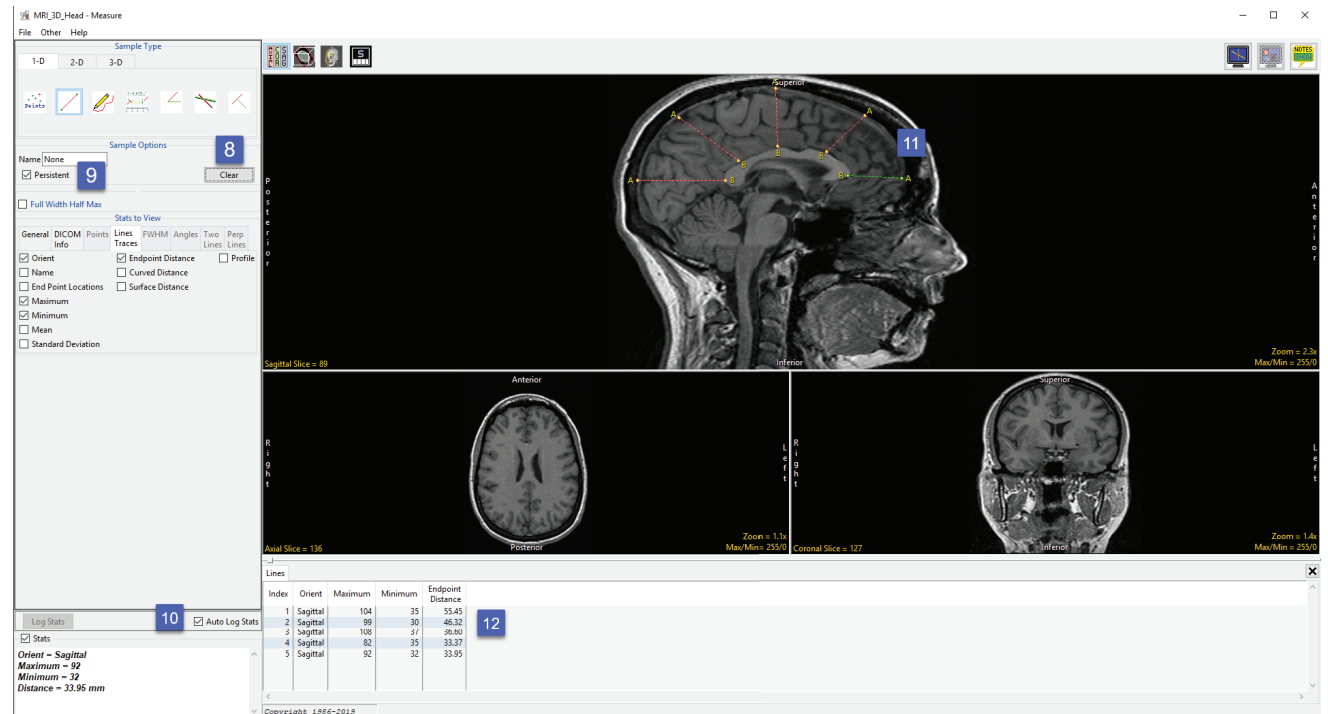
- Open Input/Output and load MRI_3D_Head.avw into Analyze.
- Select MRI_3D_Head and open Measure.
- Switch the display of the Rendering off [1] and set the primary display to Sagittal [2].
- Select the 1D Sample Type [3] and choose the Line tool [4].
- If checked (enabled), uncheck Full Width Half Max [5].
- Define a line on a sagittal slice. [6] To draw a line position the cursor on the image and press the left mouse button to begin drawing. Release the button to end the line.
- The coordinates for the line endpoints (A and B) and the line distance are reported in the Stats review area [7].





Making Line Measurements using Sample Line(s) (continued)

- Press Clear [8] to reset.
- Check the Persistent [9] and Auto Log Stats checkboxes [10].
- Define several lines on the sagittal slice [11].
- The coordinates for the line endpoints (A and B) and the line distances are reported in the log [12]. Right click to save the log as a .CSV file.





Generating Line Profiles using Sample Line(s)

The Sample Line(s) tool allows users to sample and plot pixel intensity values for a defined line.

Download the MRI_3D_Head.avw data set from analyzedirect.com/data to follow along.

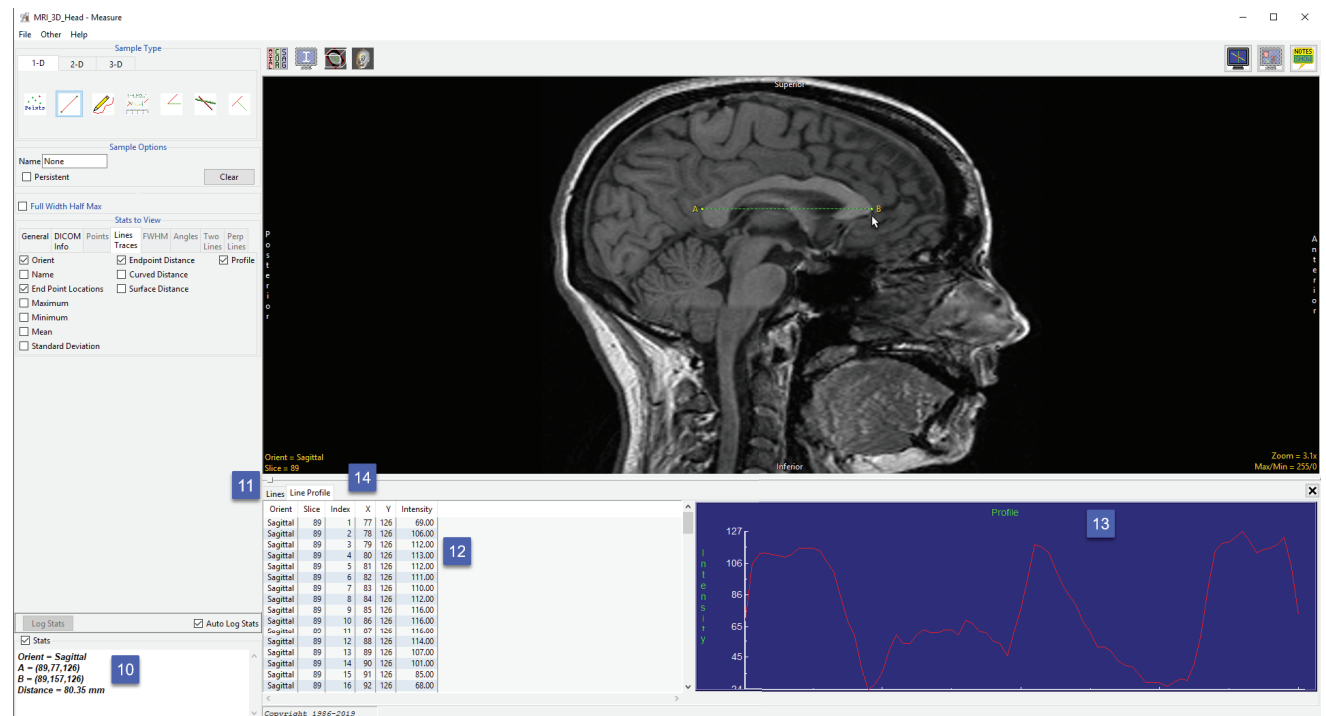
- Open Input/Output and load MRI_3D_Head.avw into Analyze.
- Select MRI_3D_Head and open Measure.
- Switch the display of the Rendering off [1] and toggle the display of all orientations off [2].
- Use the Orient option to switch to Sagittal [3].
- Select the 1D Sample Type [4]. Choose the Line tool [5].
- If enabled (checked), uncheck Full Width Half Max [6].
- Check the Profile option [7] and the Auto Log Stats checkbox [8].
- Define a line on a sagittal slice to measure the posterior to anterior distance of the corpus callosum [9].





Generating Line Profiles using Sample Line(s) (continued)

- The coordinates for the line endpoints (A and B) and the line distance are reported in the Stats review area [10] and in the Lines tab [11].
- The intensity profile of the defined line is logged [12] and plotted [13] in the Line Profile tab [14].





Making FWHM Line Measurements using Sample Line(s)

The Sample Line(s) tool allows for measurement of FWHM (Full-Width, Half-Max) distance on a line that crosses a structure of sufficient contrast to produce edges which cross the half-max value, which represents half the difference between the minimum and maximum intensity values along the line. FWHM measurements can be useful when trying to make exact measurements on a structure when placing the end points accurately is difficult.

Download the VH_Abdomen.avw data set from analyzedirect.com/data to follow along.

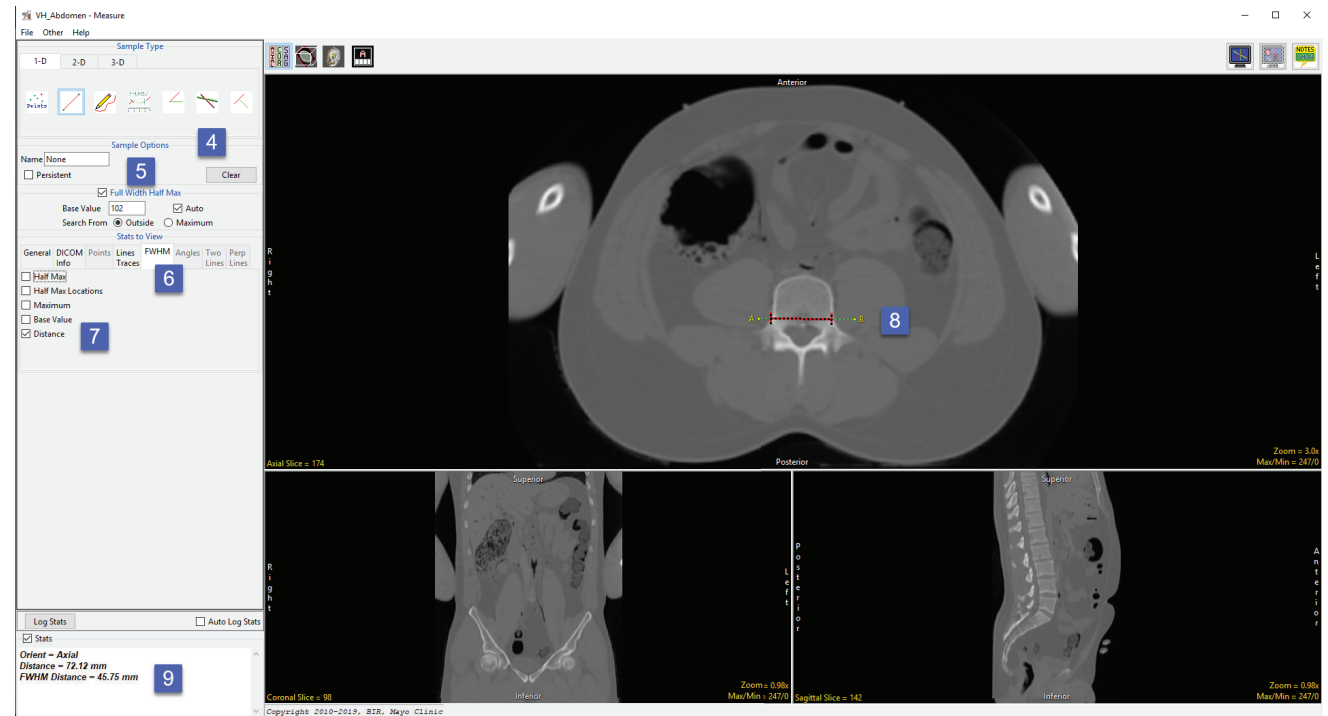


- Open Input/Output and load VH_Abdomen.avw into Analyze. Select VH_Abdomen and open Measure.
- Select the Sample Line(s) tool [1] from 1-D Sample Type.
- Define a line in the axial orientation to measure the distance from the right side of the vertebral body to the left side [2].
- Note the distance [3].



Making FWHM Line Measurements using Sample Line(s) (continued)

- Placing the endpoints, point A and point B, exactly in the correct location to obtain an accurate measurement can be difficult.
- Click Clear [4] to reset the line.
- Check the Full Width Half Max checkbox [5] and check the Auto option to have the tool calculate the FWHM Base Value.
- Select the FWHM Stats to View tab [6] and make sure Distance [7] is selected, this will report the FWHM Distance in the stats display.



- In the axial orientation, define a line across the vertebral body, however, this time do not place the endpoints of the line exactly on each side of the vertebral body [8]. Note that the FWHM is overlaid in red on the line.
- Note the distance measurement in the stats display [9]. Even if the same distance measurements as before were obtained, FWHM is a quicker and easier method than trying to accurately place endpoints.

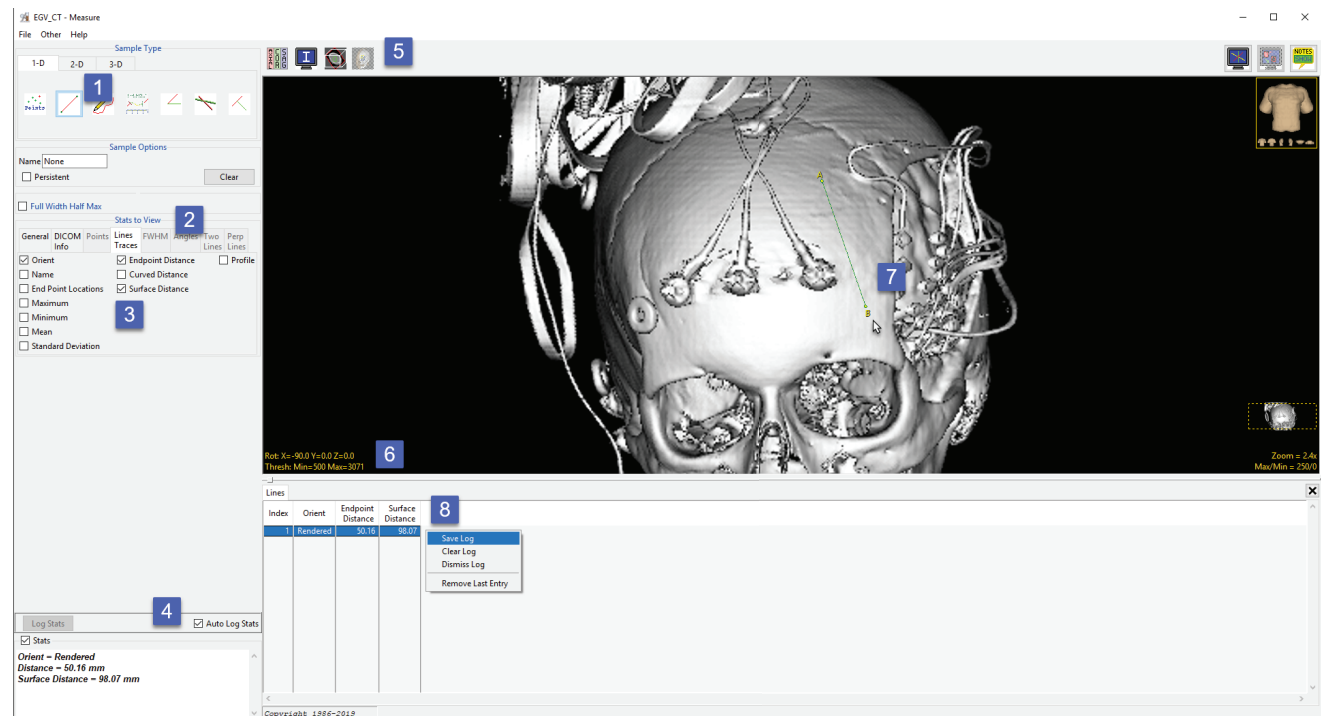


Making Line Measurements on the 3D Rendering using Sample Line(s)

Like the Sample Points tool, the Sample Line(s) tool can also be used to make measurements on the 3D rendering.

Download the EG_CT.avw data set from analyzedirect.com/data to follow along.

- Open Input/Output and load EG_CT.avw into Analyze. Select EG_CT and open Measure.
- Select the Sample Line(s) tool [1] from 1-D Sample Type.
- From Stats to View select the Line Traces tab [2].



- Ensure that both the Endpoint Distance and Surface Distance options are selected [3] and check Auto Log Stats [4].
- Use the Display control tools [5] to enable the display of the rendered image and switch off the display of the slice data.
- To view the skull, double-click on the yellow Thresh text in the lower left-hand corner and set the minimum value to 500 [6]. The skull will be displayed. Define a line on the skull [7].
- Note that both the straight line and surface distance have been reported to the stats log [8]. Note the difference in the measurements. Right-click to save the log.