



## Introduction to Horos/Osirix

Osirix (and its open source sibling Horos) is software designed for easy, straightforward visualization of CT data. They were initially designed for the clinical radiology community you will therefore notice a number of design choices in the software that are somewhat specific to that market; however, this software is perfectly functional for other research and outreach applications. Horos and Osirix are, as of the time of this writing, nearly identical for research and outreach users, differing mainly in added patient confidentiality tools available in Osirix and some minor design differences. Please note that we do not offer OsirixMD at the BRC imaging and have no setup for dealing with confidential patient data.

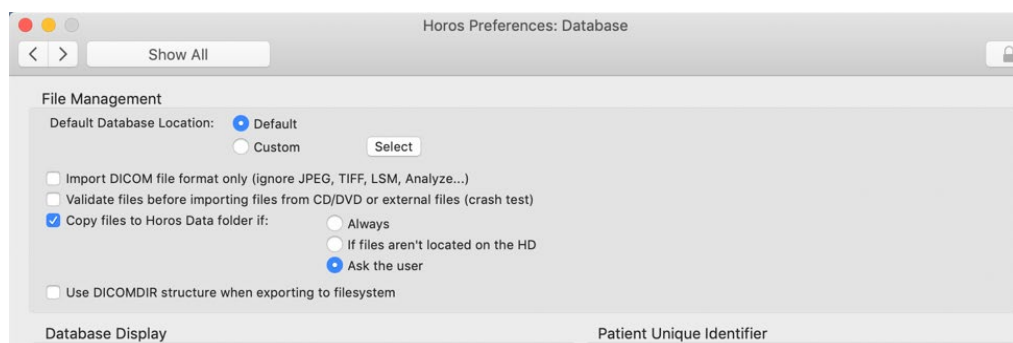
The screenshots included here were taken from Horos and may be slightly different than the ones you see if you're on Osirix, but should be similar enough to be easy to follow.

The instructions below are designed to avoid many potential problems, based on BRC-Imaging staff's experience with a lot of different data types and researcher requests. The instructions laid out here are far from the only way to get useful images, movies, or videos using Horos/Osirix, however, and I encourage you to experiment and figure out strategies that work well for your data sets.

If you have a method you prefer, feel free to share, and if you have questions, feel free to stop by the lab or contact us at [brc\\_imaging\\_ct@cornell.edu](mailto:brc_imaging_ct@cornell.edu).

### 1) Check your file type.

- If you downloaded this file from a database like Morphosource, this information should be included with the metadata for the file. If you had the sample scanned in the BRC-Imaging facility, this will be included in the file name (probably TIFF or DICOM)
- If your file is in DICOM format, you can proceed directly to step 2.
- If your file is in a format aside from TIFF, DICOM, or JPG, talk to BRC-Imaging staff about file conversion.
- If your file format is not DICOM, confirm that the preferences are set accordingly:
  - Go to Horos→Preferences
  - Click Database
  - Check that "Import DICOM file format only" is NOT checked (It should remember this setting from session to session).



## 2) Import your data.

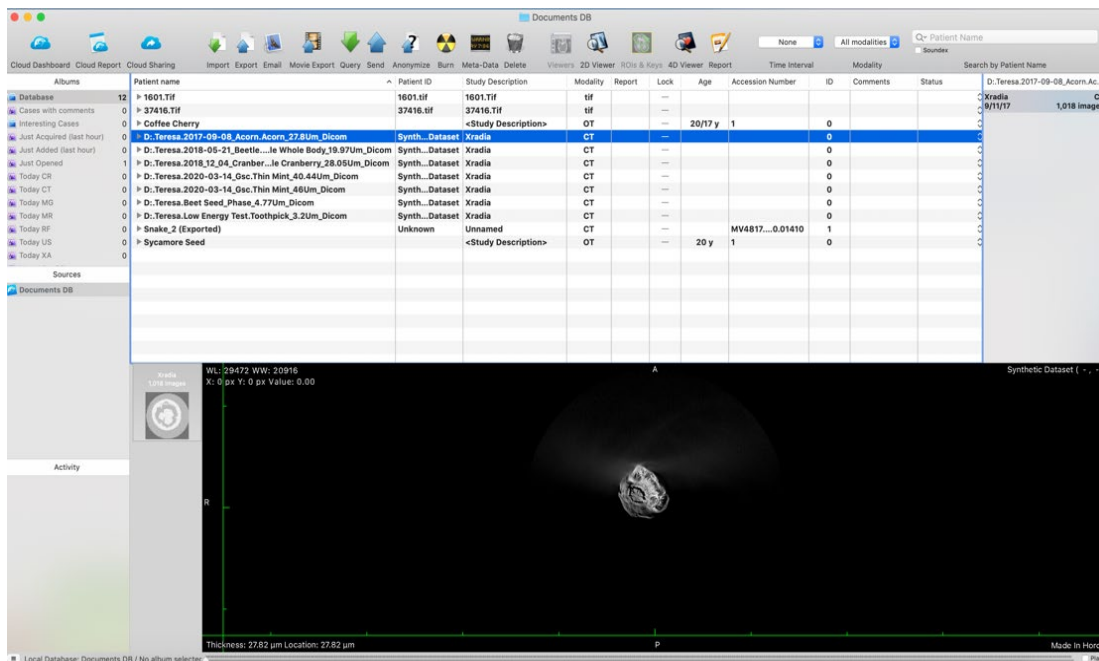
-Click File→Import→Import Files

-Select all the data files and click Open, then “Copy Files”. Some further file requirements:

-The folder will need to be unzipped if it isn't already.

-The folder may include non-data files (scanning/reconstruction recipe, specimen information, example images). Don't include these—the software is not smart enough to parse these and filter them out.

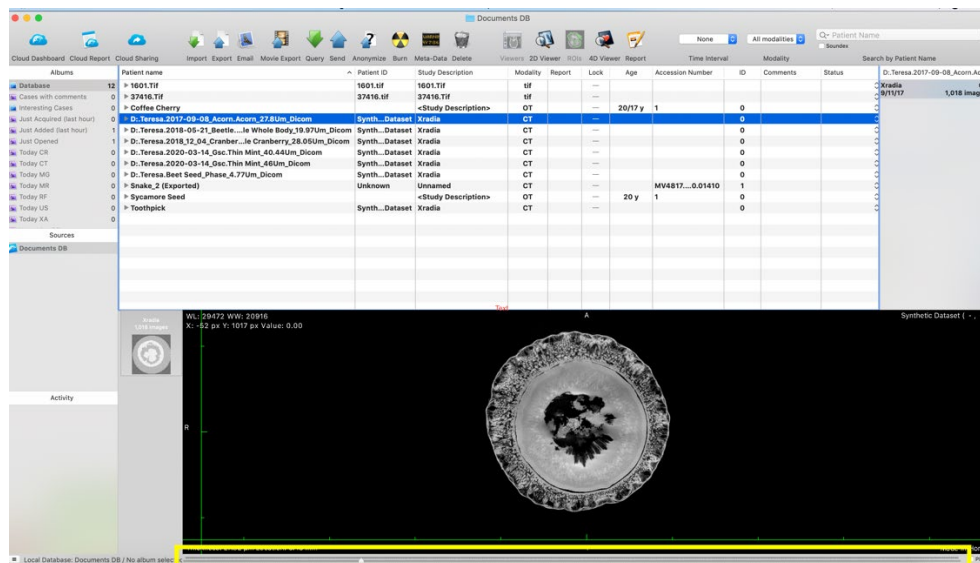
-The selected files need to be part of a continuous set (i.e., starting from file\_0001.dcm and going to file\_1000.dcm, with no jumps.) The software is not smart enough to parse discontinuities, except to warn you that they exist. If there are missing files, try downloading and unzipping the data again, and/or discuss this with the staff member who performed the scan. Note that the data CAN start or end at any arbitrary number, everything in the middle just needs to be continuous.



## 3) Select your file.

-After downloading, your file will appear on the database list in the middle portion of the screen. Note that Horos is software that came from the medical community, so you'll see data like “Patient name” and “age” which may or may not be meaningful to you. (The patient names on TIFF files made outside the BRC can be especially arbitrary.)

-When you click on a file name, a preview of that data set will appear in the window on the bottom. There is a scrollbar and handle at the very bottom that you can use to review the data before selecting it for viewing. (Scrollbar highlighted in yellow below).

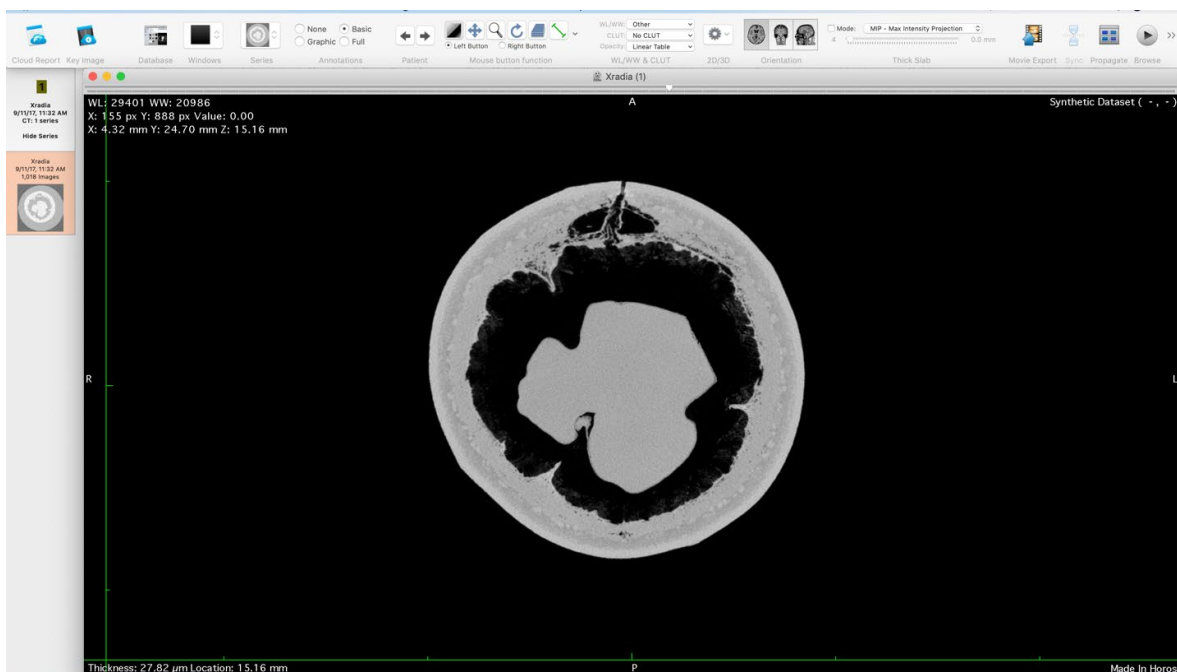


#### 4) View your data in 2D (Note you need to do this first even if you only want to view in 3D)

-Click on the dataset of interest and click the “2D Viewer” icon along the top bar.

-If you don't want to look at your data in 3D you can skip to the 3D section.


#### Orientation to Standard 2D view:





-The scrollbar that was in the bottom in the document database view is along the top here. A description of the most useful functions on the menu bar are below


## Mouse button functions:


The mouse button functions affect a variety of aspects of the way the data is being displayed.


Clicking the brightness  button: Holding down the mouse button (or touchpad) while on the dataset allows changes in brightness and contrast. Left-to-right changes contrast, up and down changes brightness. Please note that very small mouse movements lead to relatively large changes in brightness and contrast, so keep movements pretty small (just a few mm at a time) until you have a pretty good sense of how to play with your dataset. If you end up in a place where you can't seem to get back to a normal range, try the Window Width and Level (WL/WW) drop down menu (see below).

Clicking on the movement  button: Holding down the mouse button while hovering on top of the dataset allows you to move the whole slice around. This can be useful if you want to zoom far into a particular slide.

Magnifying glass : Will zoom on the selected slice.

Rotate button : Will rotate the orientation of the selected slice

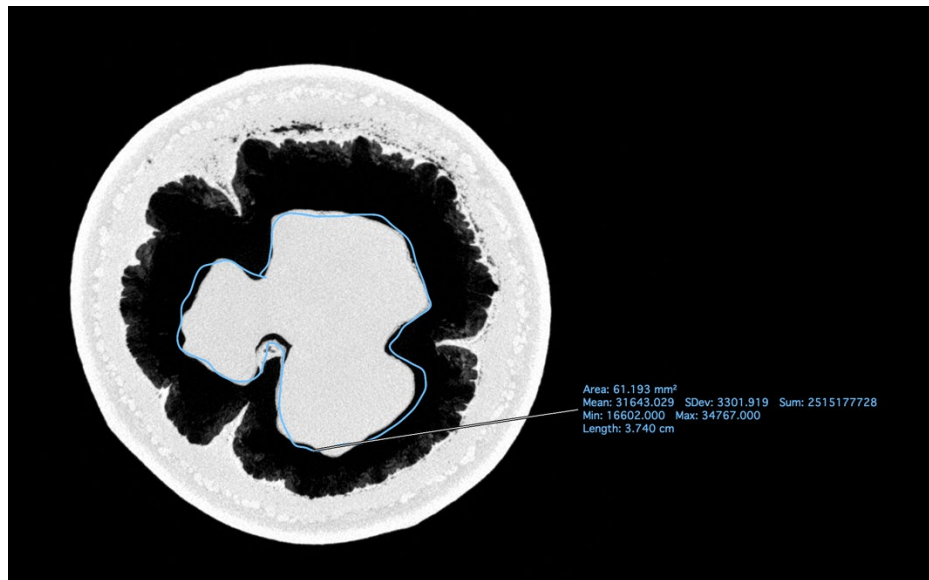
Stack of paper button : Same function as the scrollbar along the top, holding down the mouse button (or touchpad) while moving will move through the slices in the dataset.

Measurement tool : Will measure a length in mm. (Note: with a non-DICOM data set it might measure in pixels and may not measure at all.)

There are a variety of other measurement tools, of varying use to a non-clinical researcher with more powerful analytical tools available. All measurements are either in mm (on DICOM) or pixels (on other data types where the resolution has not been entered) unless otherwise noted. One quick note on the output from a measurement that outputs surface area (circle, rectangle, pencil, closed polygon)

-Area and Length are pretty self-explanatory.

-Min/Max/Mean/SDev/Sum all refer to the brightness of the pixels in the selected region. This value is unaffected by adjusting brightness or contrast (which changes the display but not the raw data behind that display.) This info might be useful if you are looking for some general presets in image segmentation elsewhere.



### Orientation:

Changes the orientation of slices through the scan. (May not be available for non-DICOM file types). The software shows an axial, coronal, and sagittal view as would be standard in clinical CT scans, but your sample may or may not correspond perfectly to these orientations.

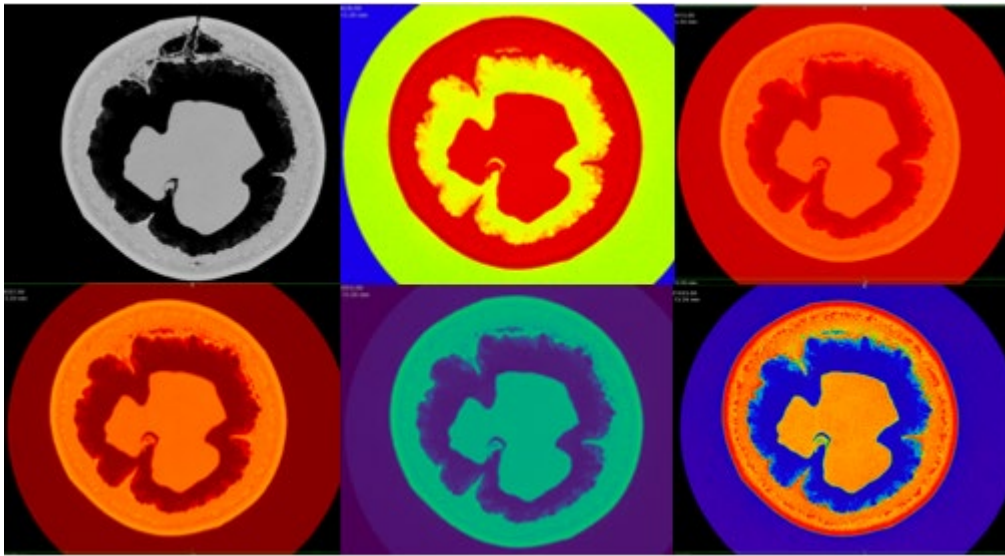
To view more than one orientation at once, or change the angle through which you're slicing, refer to the section below labeled "Other 2D Views".

### WL/WW and CLUT:

Window Width and Level (WL/WW) refers to what most other imaging modalities refer to as brightness and contrast. Adjusting this does not change the data itself, just how it's being displayed. To make changes to the data itself (for example, to highlight one particular region that is hard to highlight through contrast changes alone), please contact BRC staff to discuss other software options.

The "Default WL/WW" and "Full Dynamic Range" are usually good starting points for adjusting brightness and contrast. They are also useful if you've adjusted the brightness and contrast to a point that is hard to get back from (for example, a completely black, white, or binary view when you want a grayscale image.) The other presets are less relevant to a non-clinical CT scan, although if you regularly work with similarly-scaled data sets (for example, calibrated images), making your own preset brightness range using the WL/WW drop down menu may be useful.

CLUT stands for Color Look-Up Table, and it describes different sets of colors that can be used to display the data. In the CT field, black/gray/white or black/red/yellow/white are the most common CLUTs used. Others may show your data well, but they are usually more visually striking than scientifically useful, as you can see below in this set showing the same data set with a few different Horos CLUTs applied and adjusted for comparable brightness and contrast.



### Thick Slab:

In typical 2D mode, you are looking at a single reconstructed “slice” through the data. Thick slab mode allows you to look at a projection of more than one slice at a time. This can be useful for seeing a greater depth of the sample at once, decreasing noise, or to show two features that are very close but not perfectly aligned. Click the toggle button to enable Thick Slab mode.

Thick slab modes can be changed with the drop down menu and include:

**Mean:** Shows an average brightness of each pixel over the number of slice selected. Decreases noise but increases blurriness.

**Maximum Intensity Projection (MIP):** The MIP goes through every pixel within the selected slice range and selects the brightest pixel within that range. Can be useful for highlighting delicate-but-bright structures in a comparatively dark area.

**Minimum Intensity Projection (MinIP):** The MinIP is the opposite of the MIP; it shows the darkest pixel within a particular range. Can be useful for highlighting small dark features in a bright area.



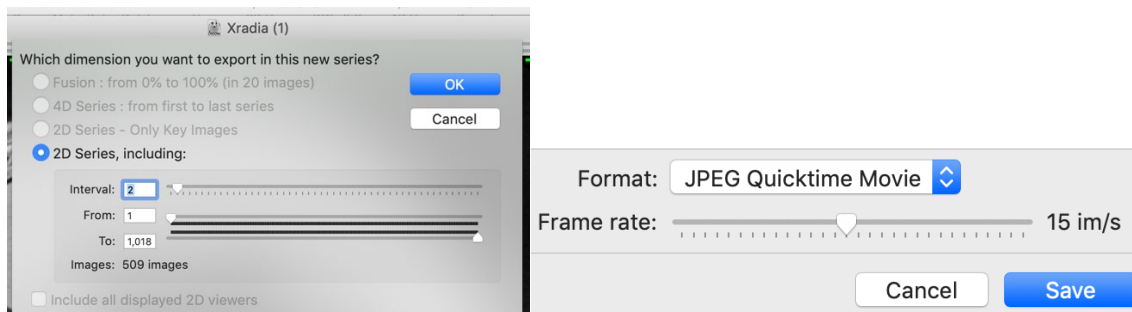
## Image Export:

Any image can be exported at any time by going to File→Export→ whichever file type you'd like to export. You can also take a screenshot. Any information shown on the screen will be included when you export an image, and Horos will crop out any of the image that is outside of the data set. The image below is a totally uncropped exported TIFF.



## Movie Export:

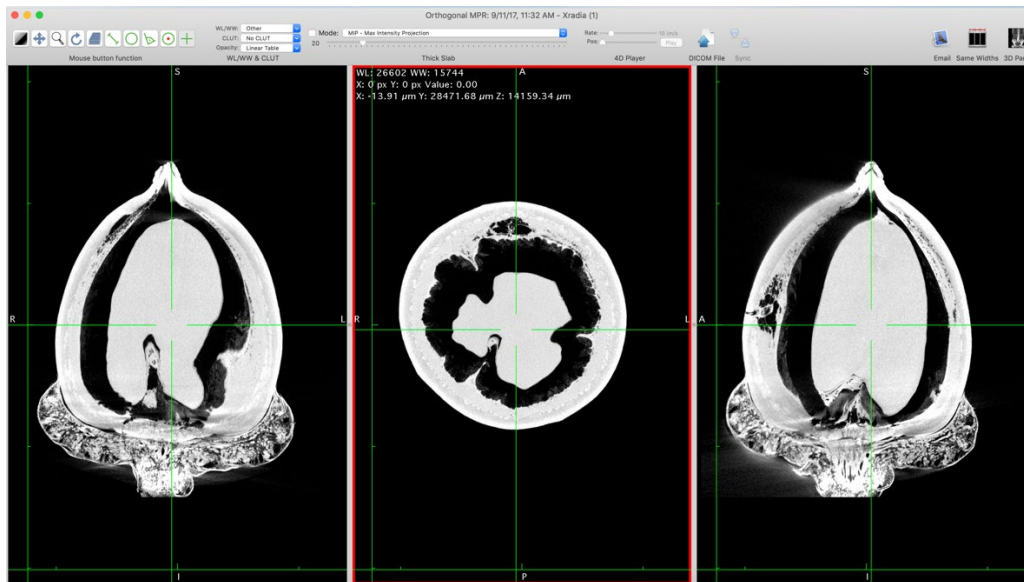
Movie Export allows you to create a movie through a selected range of slices. That video will use whatever WL/WW, zoom, thick slab, etc. visual settings that your image is currently set to.



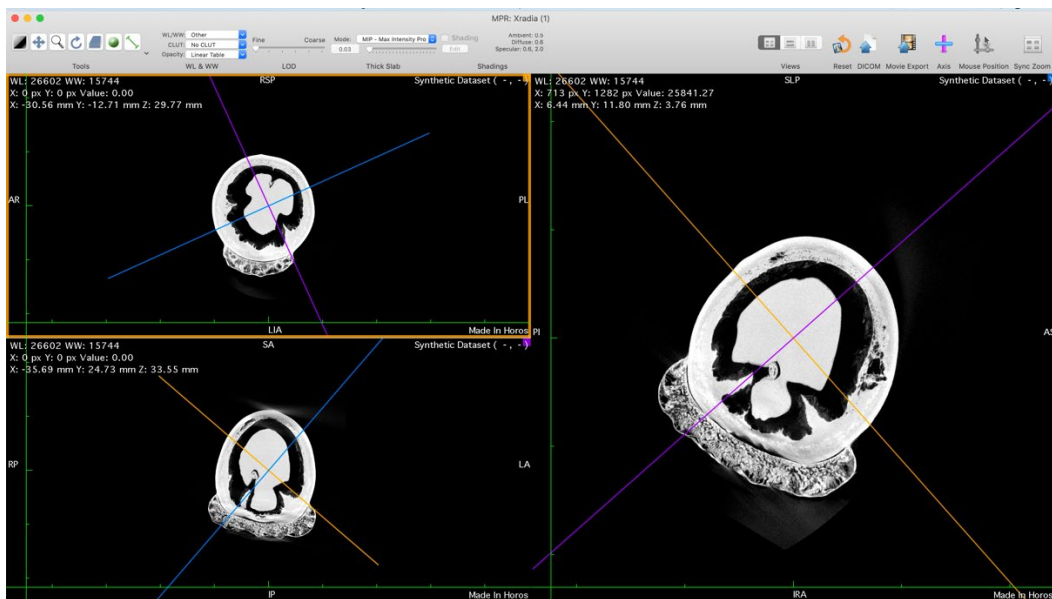
(I recommend that you try saving videos with a few different frame rate and image settings to determine what parameters best suit your needs. The 2D videos render quickly.)

## Other 2D Views:

-To see all three orientations at once, select 3DViewer→2D Orthogonal MPR



-If you'd like to change the angles of the slices through the specimen, you can do so by going to 3D Viewer->3D MPR:



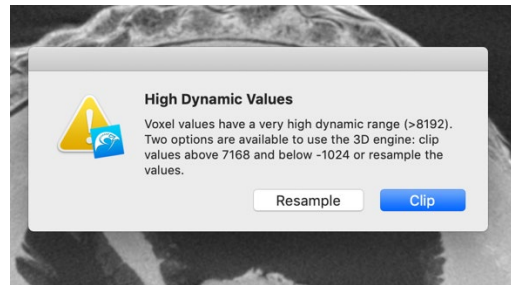
-In 3D MPR, the other planes through the specimen are represented by the lines on the image. They can be moved by clicking and dragging at the point where they intersect (a hand will appear). They can be rotated by clicking and dragging at any other point along either line (a rotation symbol will appear).



## 5) View specimen in 3D mode

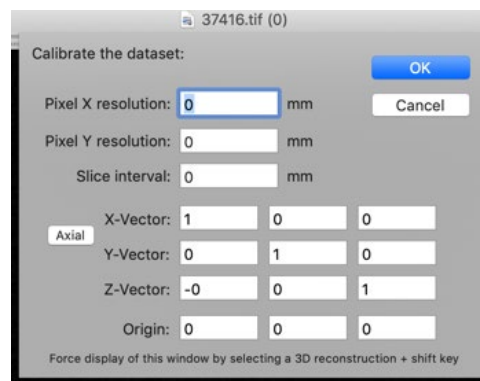
Go to 3D Viewer→3D Volume Rendering

-For CT data with images higher than 12 bits in bit depth, the software will ask you to resample or clip the data. Choose Resample, which will compress the full 16-bit data. (Clipping will just set every value higher than 7168 to the maximum, and with typical 16-bit datasets, you'll lose the vast majority of gray levels in your region of interest.)



For non-DICOM data sets, you will be asked to enter the resolution in mm/pixel in x, y, and z. This information will have been included in your file if it came from the BRC, on the download page if it came from Morphosource, and should otherwise be accessible in metadata or by contacting the person who performed the scan if it's not otherwise visible. All other values can be left as-is.


If you aren't sure about the resolution but want to see the data and don't plan on taking any measurements at this time, setting x, y, and z to 1 is usually a safe choice. Horos doesn't save these values, and you'll be asked for them again the next time you load the dataset in 3D.



## Menu bar orientation

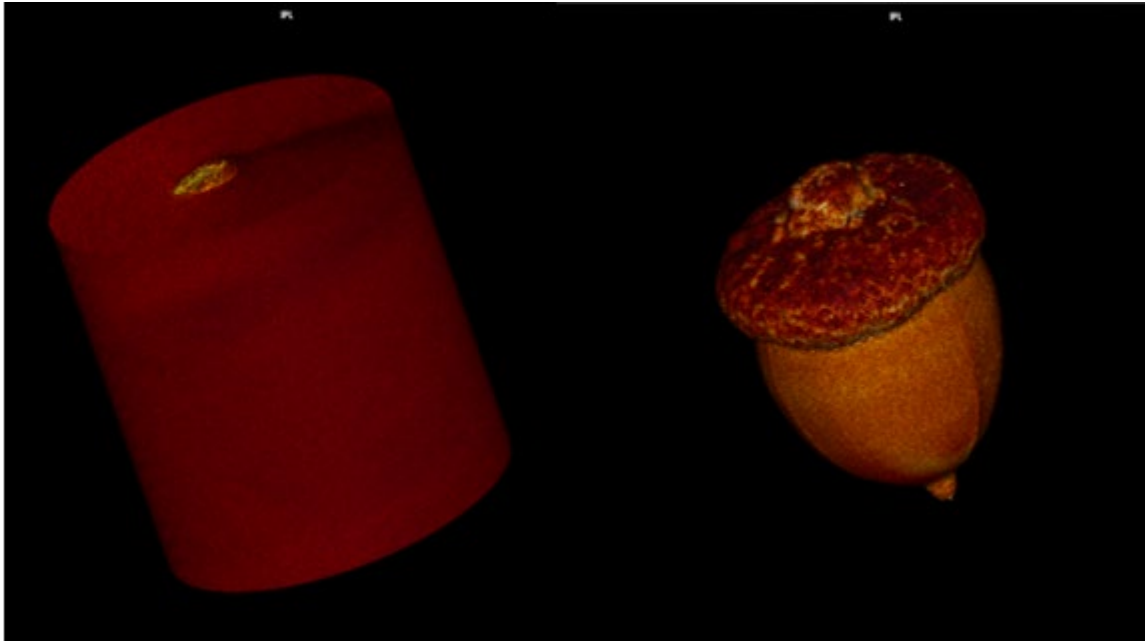
### Mouse button functions:


The mouse button functions affect a variety of aspects of the way the data is being displayed.

Clicking the brightness  button: Holding down the mouse button (or touchpad) while on the dataset allows changes in brightness and contrast. Left-to-right changes contrast, up and down changes brightness. Please note that very small mouse movements lead to relatively large changes in brightness and contrast, so keep movements pretty small (just a few mm at a time) until you have a pretty good sense of how to play with your


dataset. If you end up in a place where you can't seem to get back to a normal range, try the Window Width and Level (WL/WW) drop down menu (see below).


Adjusting brightness and contrast in 3D also adjusts the transparency of the 3D object. If your starting point looks like a solid cylinder, that's because the WL/WW are set in a way that makes the whole dataset, including air, opaque. In the two comparison images below, I held down the mouse button and scrolled up slightly to make the specimen visible.




Clicking on the movement  button: Holding down the mouse button while hovering on top of the dataset allows you to move the whole 3D visualized object around.

Magnifying glass : Will zoom in on wherever you clicked.

Rotate button : Will rotate the orientation of the dataset.

3D movement button : By clicking and dragging, allows full rotation of the 3D dataset.

Measurement tool : Will measure a length in mm.

## WL/WW

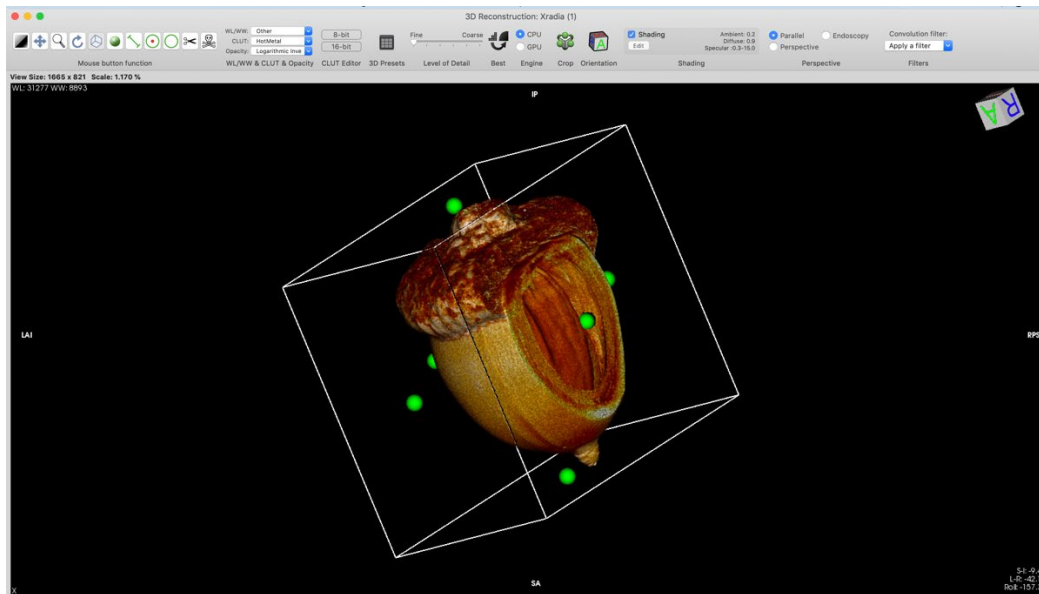
For more information about Window Leveling and Width, refer to the WL/WW section in the section on 2D. One additional note: in 3D, the CLUT includes not only color but transparency, which can give a different overall effect.

## Level of Detail

Changes the level of detail visible on the screen. If your computer is responding so slowly that it's difficult to work with the data set, choosing a coarser setting will make it respond more quickly. If you want to be able to confirm a fine detail on the surface, choosing a finer setting will allow you to do that at the cost of processing speed.

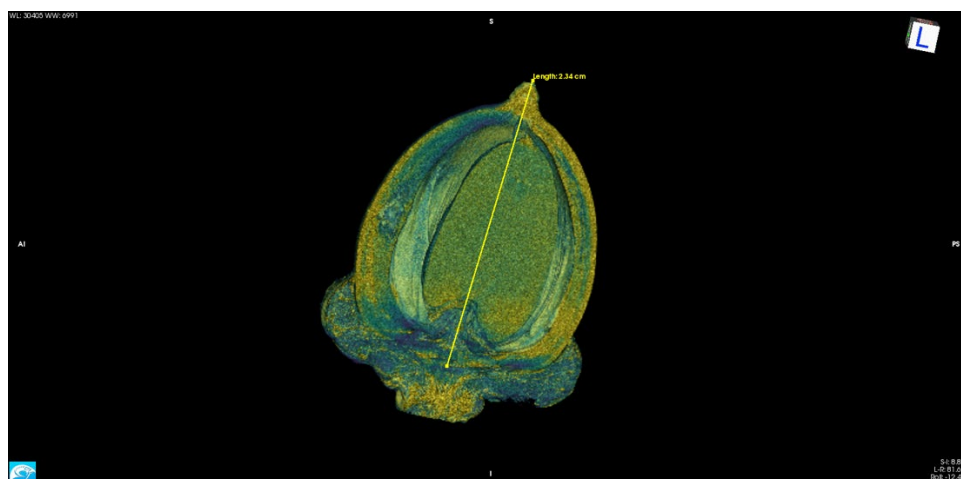
## Crop

When you click the crop button, a handled box will appear over your data. Clicking and dragging on one of the green handles will crop into the dataset. Clicking and dragging one of the box faces (but not on a green handle) will rotate the entire cropped box region. Clicking and dragging an area outside of the crop box will rotate the entire dataset.



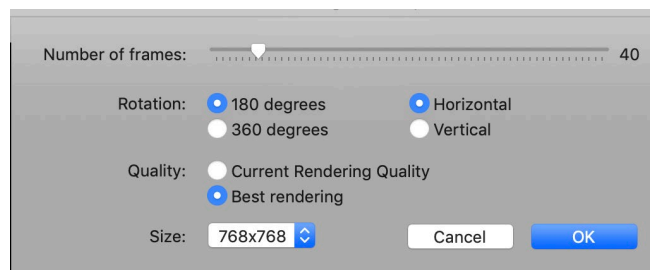
## Image Export

Any image can be exported at any time by going to File→Export→ whichever file type you'd like to export. You can also take a screenshot. Any information shown on the screen will be included when you export an image, and Horos will show the full screen area of whatever you are looking at, even if there is empty space around the scan. The image below is a totally uncropped exported TIFF.



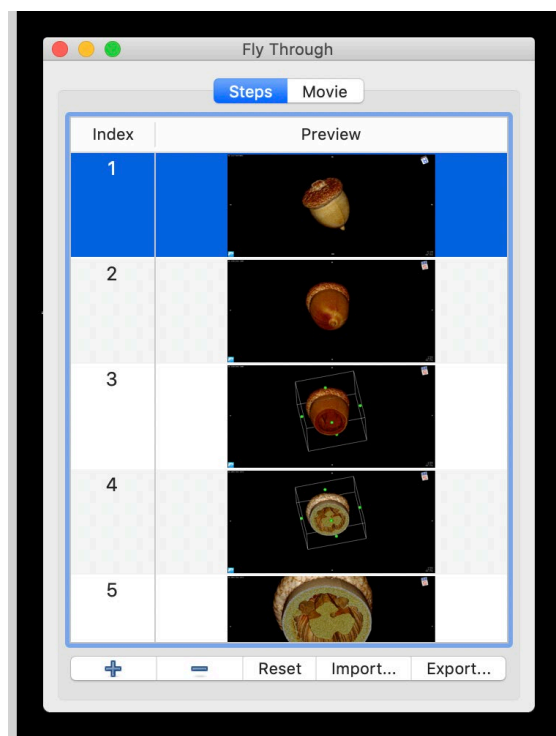
## Making a video

A simple video showing the sample rotating around an axis can be made by clicking “Movie Export” and following the prompts.

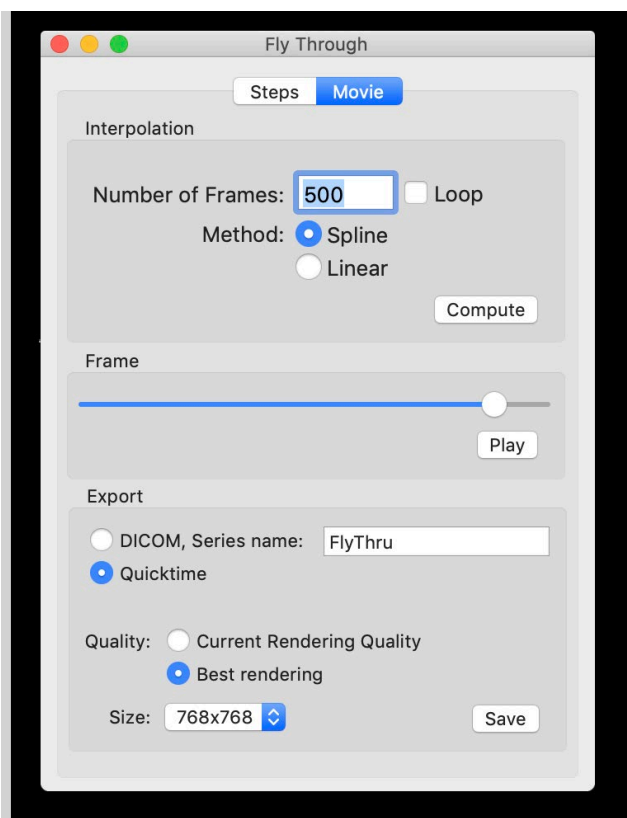


Fewer frames and poorer rendering quality will create a video faster; increasing the frames, size, and rendering quality will take more time but result in a more impressive-looking video. Personally, I often make a low-quality video to start with to confirm that my settings are reasonable before upping the quality and processing time, since for large files, this process can take a lot more time than any of the setup.

A more complex video can be created using Horos' Fly-Through mode. Bring up the Fly Through window by clicking 3D Viewer→Add Fly-Thru Point.



The Fly Through mode allows you to choose what angle, brightness/contrast, cropping, zoom, etc. that your sample will be viewed at, at various times during the video. The image above shows 5 points that were selected by making adjustments to the data and then clicking the + sign at the bottom of the window. When you set up a video, Horos will fill in the intermediate time with smooth transitions from one point to the next. When you have your desired points set up, switch from the “Steps” tab to the “Movie” tab (visible at the top of the Fly Through window):



As with the simpler movie maker, increasing the number of frames, image size, and rendering quality will result in a video that takes more time to render. I recommend starting with a relatively low number of frames and slow frame rate to confirm that the video proceeds how you expect—it's pretty intuitive but it can take a little bit of practice to figure out how best to orient the viewer before zooming/cropping/etc.