Tutorial – Reorienting 3D data

Premise: Often, volumetric data are captured where the slices do not follow the natural symmetry of the object. For example: the bilateral symmetry of an animal or the orientation of fibres in a materials sample.

Key terms

Voxel – three-dimensional pixel

Interpolation – the process of changing known voxel values (such as greyscale) to new unknown values following an operation that induces a change in the data, such as voxel size or the transformation of voxels onto a new grid. The 2D equivalent of interpolation is the easiest to visualise (Figure 1).
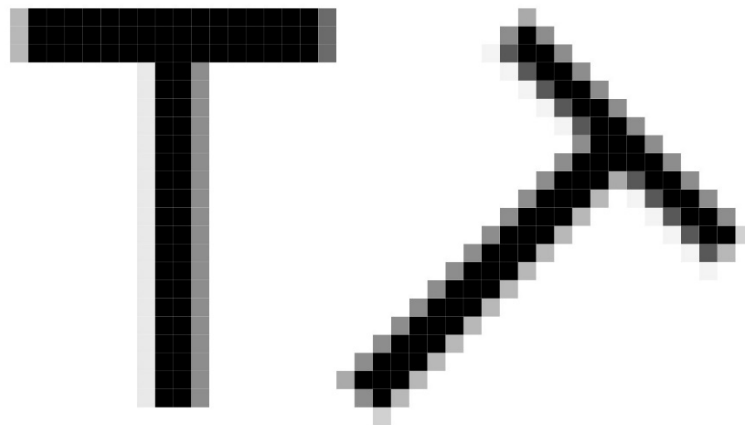

Figure 1. The letter T transformed by rotation by 45 degrees. Pixel values are interpolated to new values according to their altered position on the grid.
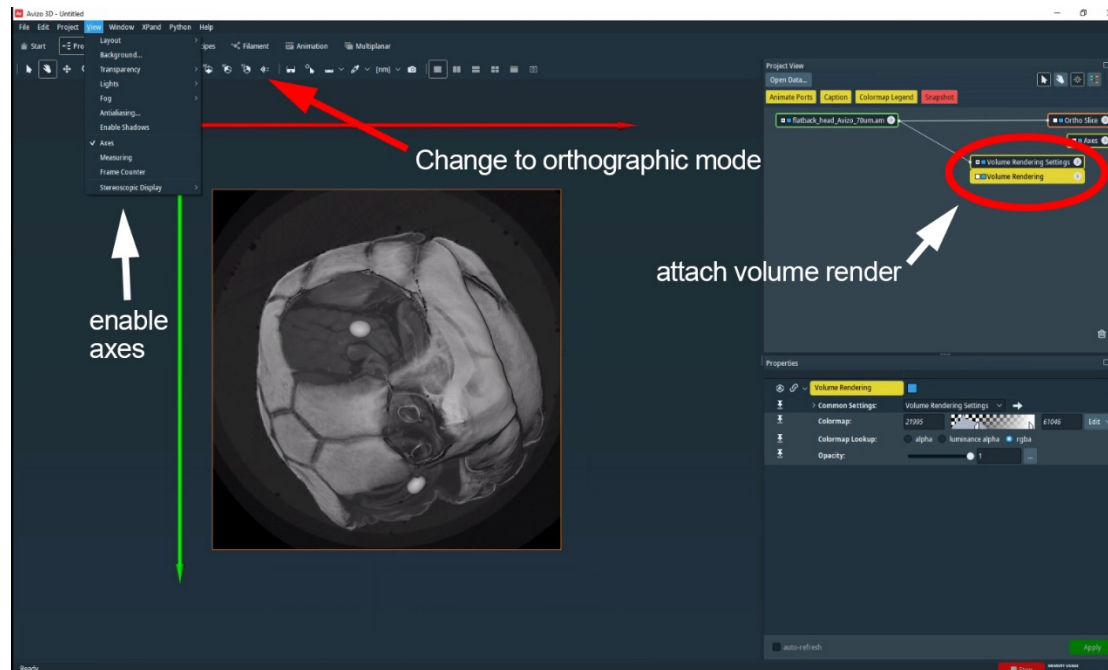
Considerations prior to re-orienting 3D data

- How will interpolation change the features you are wanting to observe/measure?
- Should re-orientation be done before or after noise reduction (filtering)?
- Do you have multiple volumes (data sets) that require re-orientation? I.e. will you be performing image registration?
- What orientation should be chosen?
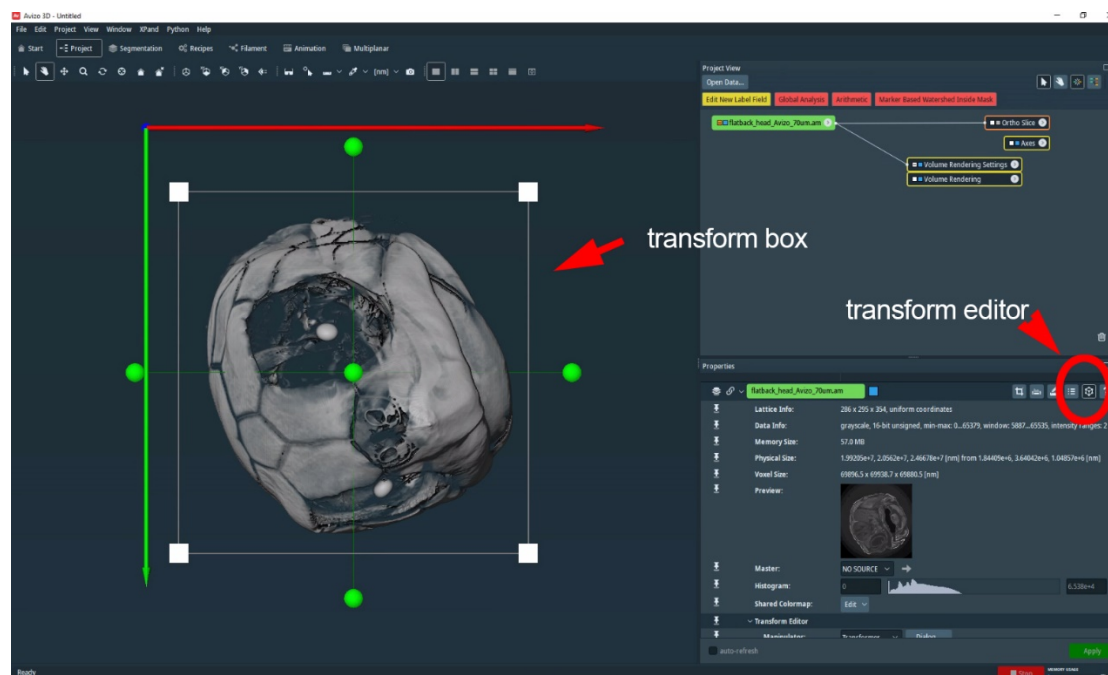- Are vectors important for your data? I.e. directionality.

NOTE: Interpolations should be kept to a minimum as iterative interpolation will incur additional alterations to pixel/voxel values. For example, the letter T in Figure 1 has undergone a single rotation to 45 degrees. A second rotation to 90 degrees should be done from the original, not the interpolated, version.
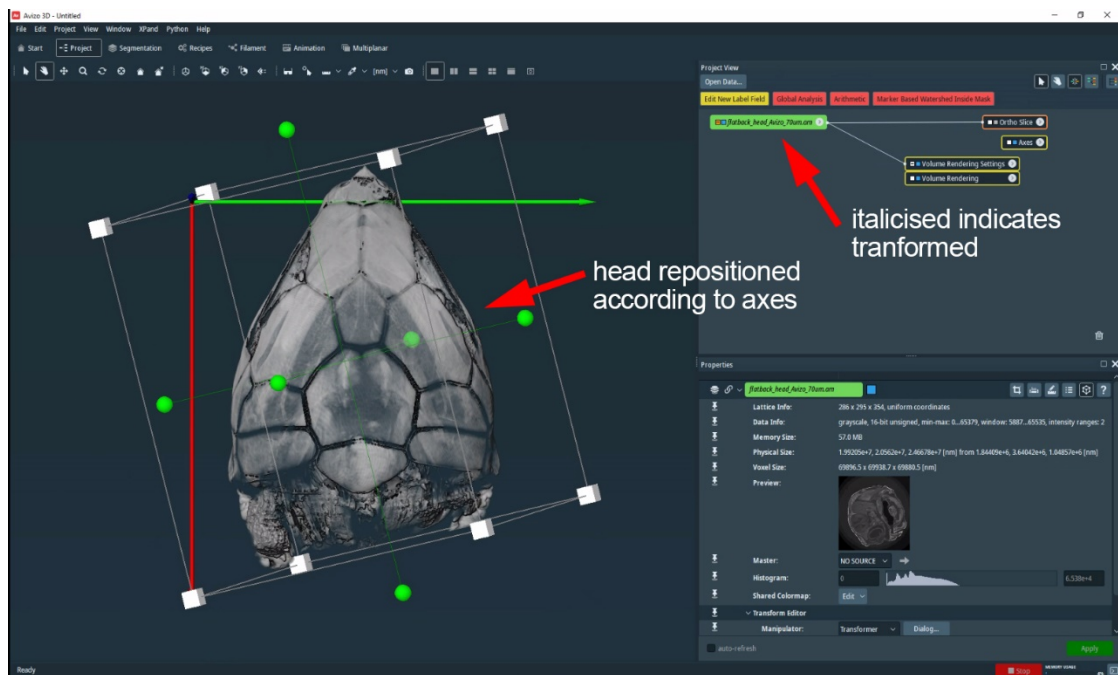
Re-orientation using Avizo 3D (2021.1)

1. Load tutorial dataset flatback_head_Avizo_70um.am
2. Attach a volume render module to visualise the head in 3D. Use the colourmap editor to adjust the range so that the skull is visible.
3. Attach an axes module by clicking View > Axes
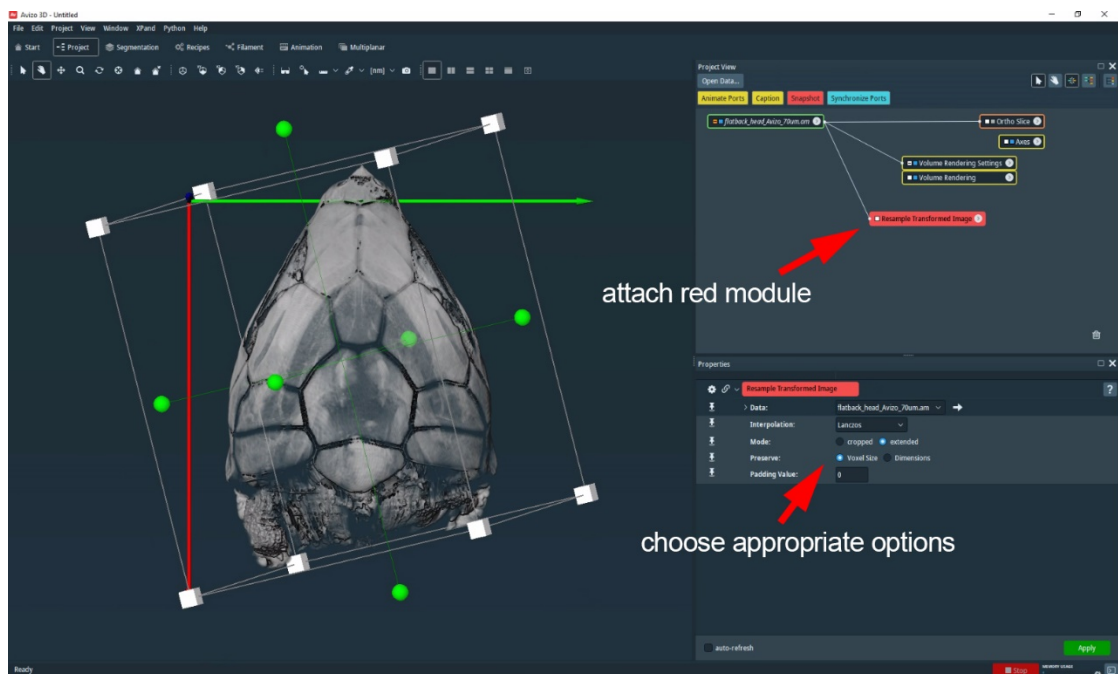4. Ensure you are in orthographic mode, not perspective mode.

5. Click on the green flatback_head_Avizo_70um.am data module and open the transform editor. This will reveal the manipulator that will allow you to reposition the head to the desired orientation. Feel free to experiment with the other manipulator options.
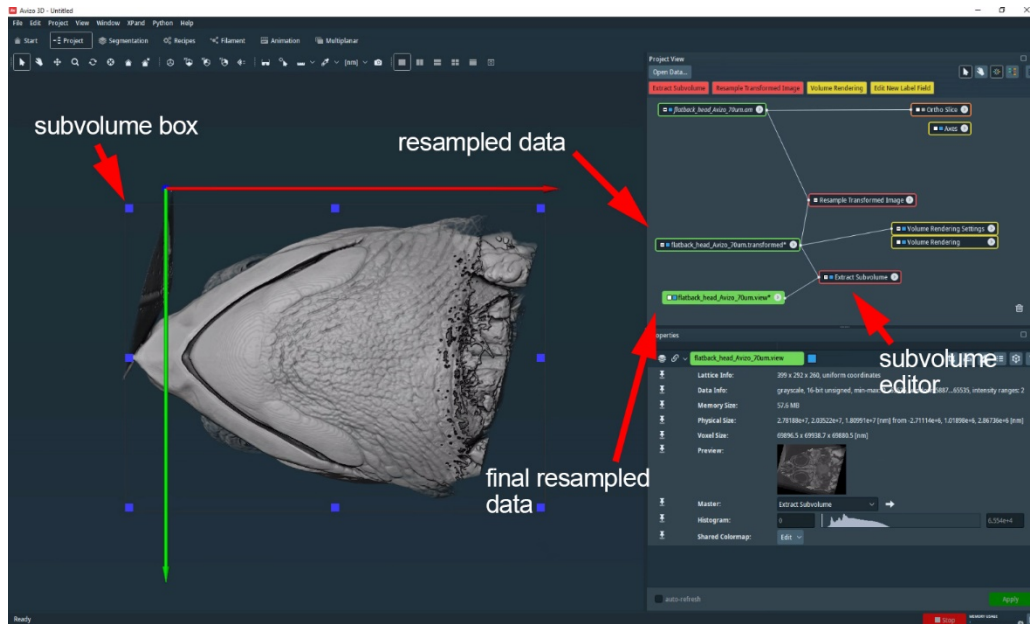
6. Using the X, Y and Z axes as a guide, reposition the head to the desired orientation. Note: Z (blue arrow) is normally the up direction. Note: the name of the dataset in the green module has become italicised. This indicates that the data has been transformed.

7. Attached a red Resample Transformed Image module to the green data module. Select the desired interpolation method. Lanczos typically gives a better result. Choose the extended mode, otherwise you may crop relevant parts of the data. Click Apply.

8. Disable the transform editor on the original data and move the yellow Volume Render module to the newly created transformed dataset. You will need to readjust the colourmap to see the skull. Note the asterisk* at the end of the new green module. This indicates that the data has not been saved. Because the extended mode was used, the new dataset will be larger than the original. Attached a red Extract Subvolume module to the transformed data and adjust the blue cornered box to only include the region of interest. Click Apply.

9. The final result is displayed with a .view extension to the filename. Your data is now re-sliced according to the new orientation. Move the yellow Volume Render module to the new dataset and adjust the colourmap as before. You may delete unnecessary modules, such as the uncropped transformed data and hide unwanted modules by clicking the blue squares on the module. Attaching an orange orthoslice module to the final file will allow you to visualise the slice orientation. Here we have used three orthoslices to demonstrate the new slice orientation in the XY, XZ and YZ plane. Remember to save the new dataset.