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).

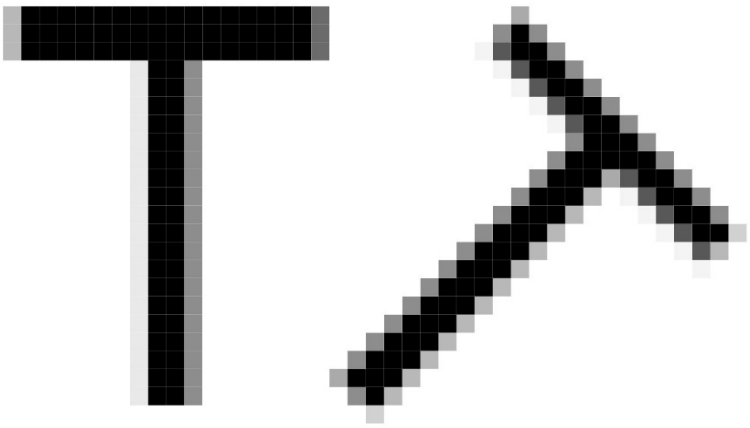


Figure 1. The letter T transformed by rotation by 45 degrees. Pixel values are interpolated to new values according to their altered position on the grid.

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.

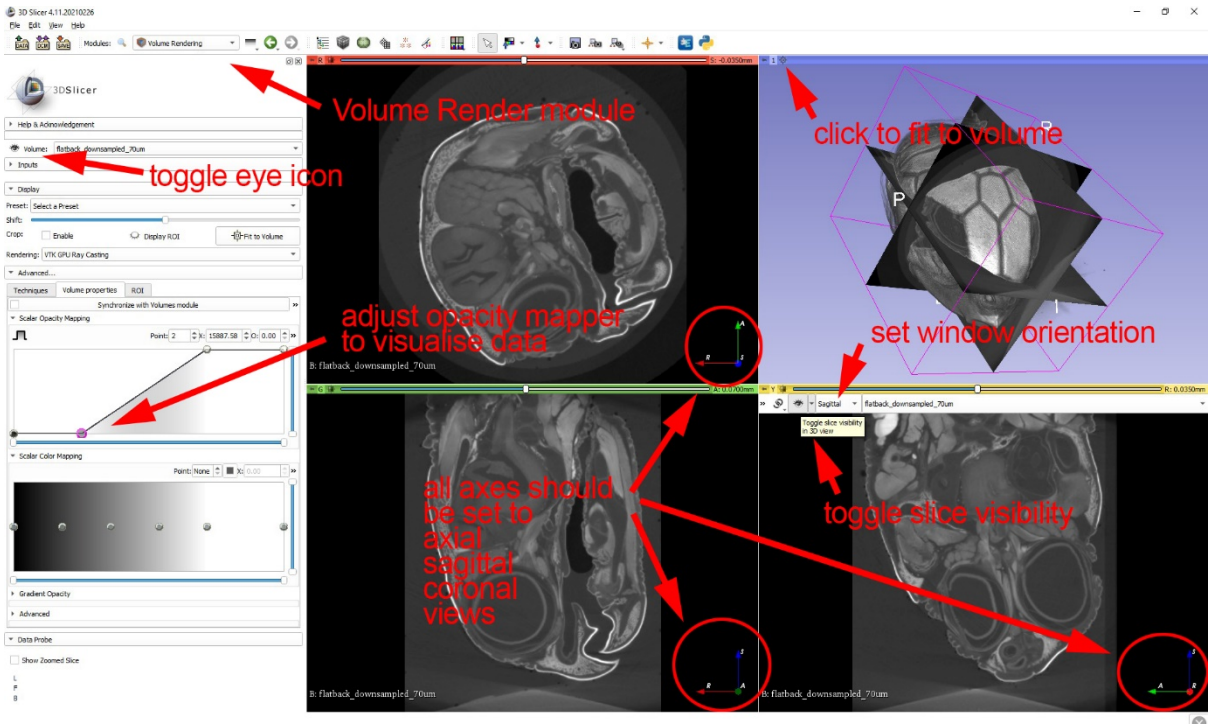
Re-orientation using 3DSlicer

(version 4.11.20200930 r29402 / 002be18)

Before opening your data is helps to ensure some defaults are set to help you navigate your data.

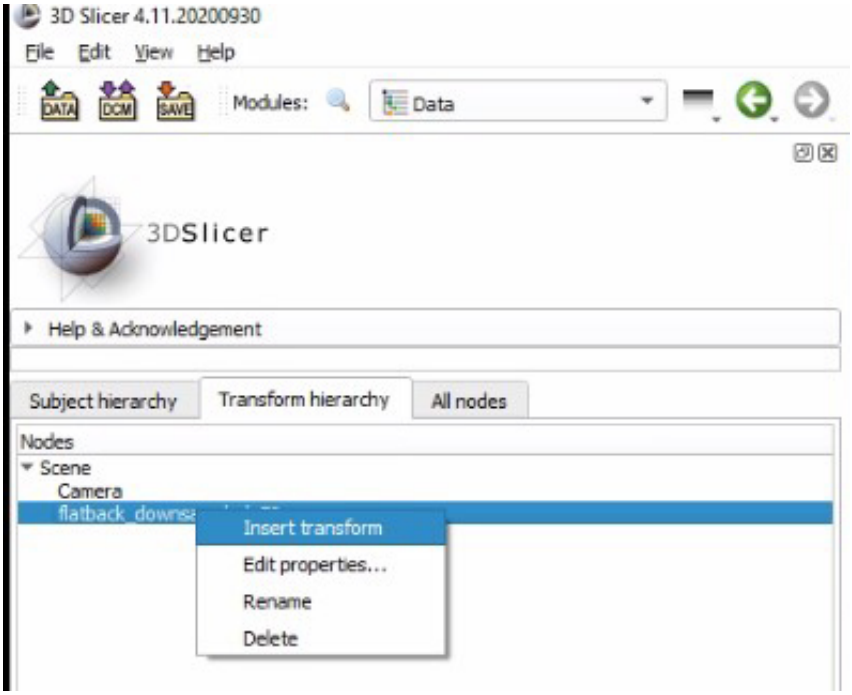
Edit > Application Settings > Views > Under “Slice viewer defaults” ensure the orientation marker is set to “axes”.

1. Open data in 3DSlicer
2. Visualise the data by:
    a. Modules menu > Volume Rendering (ensure eye icon is open) (optional)
    b. 3D View window > click “Fit to volume”
    c. Visualise each RGY slice window in the 3D View window by hovering mouse over pin and toggling the slice visibility (eye icon).
    d. Ensure each of the RGY slice windows have the axes visible and are set to axial, coronal and sagittal, respectively.

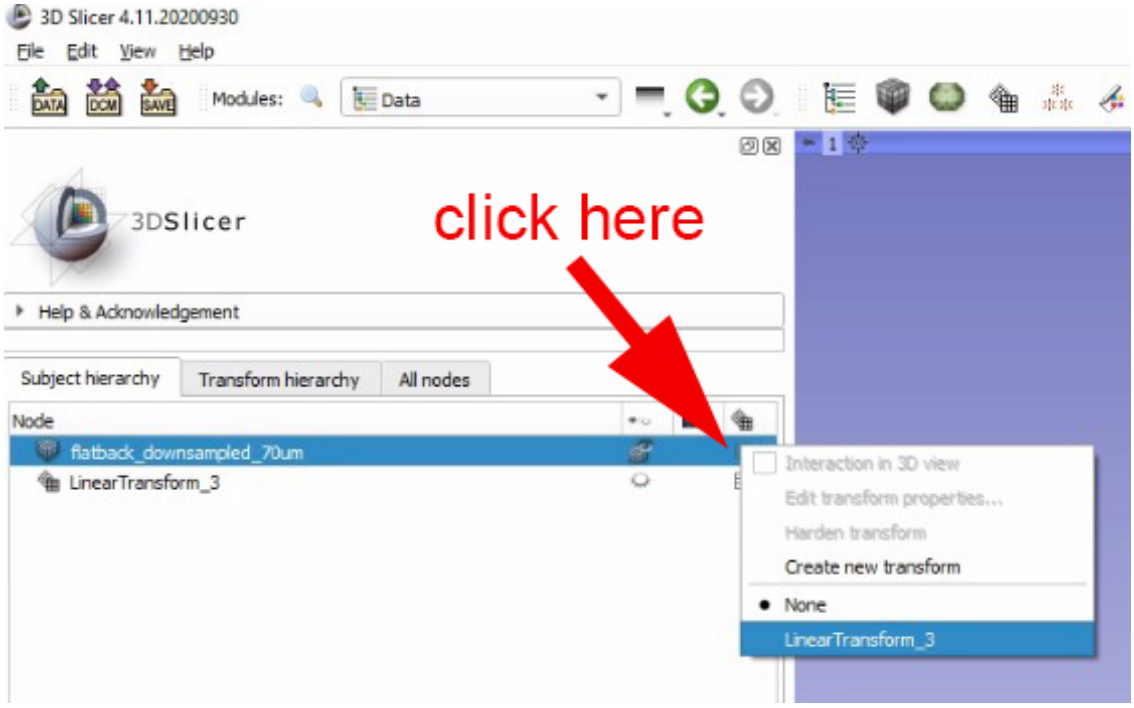


3. Modules menu > Data

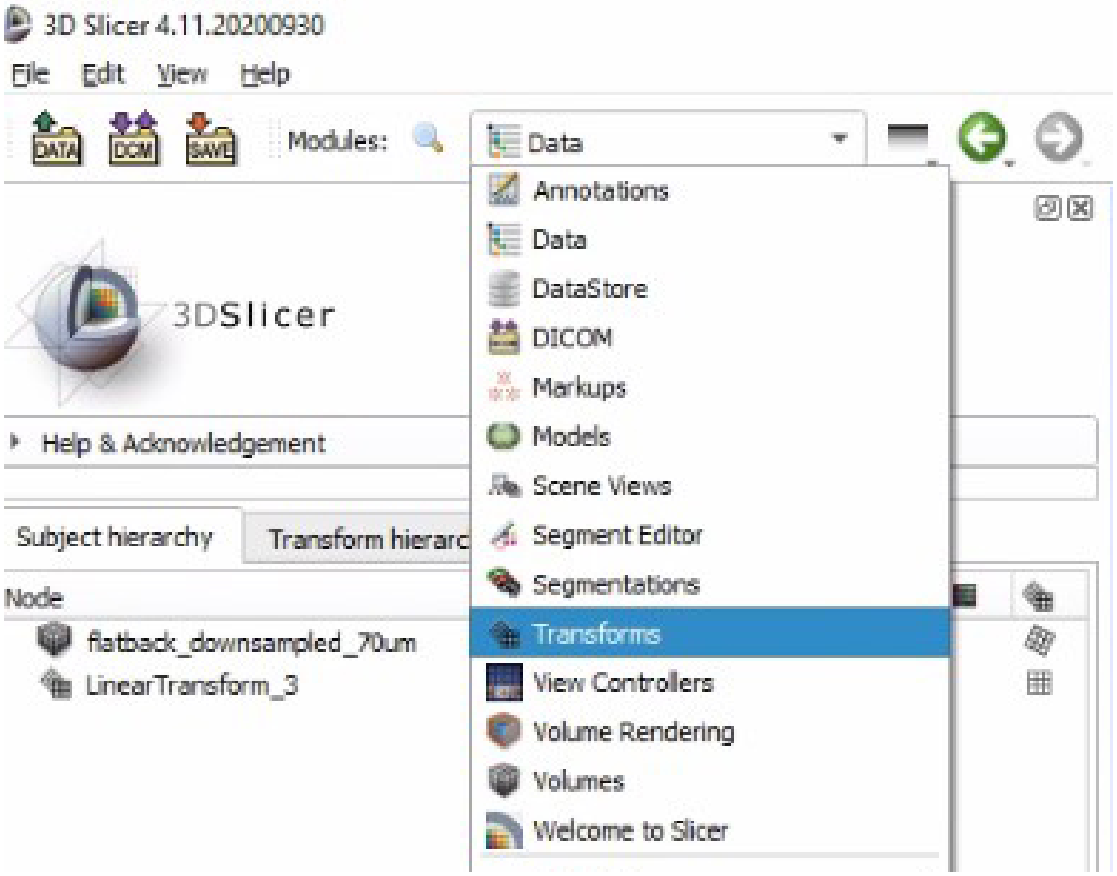
4. Transform hierarchy (Tab) > right click data > Insert transform



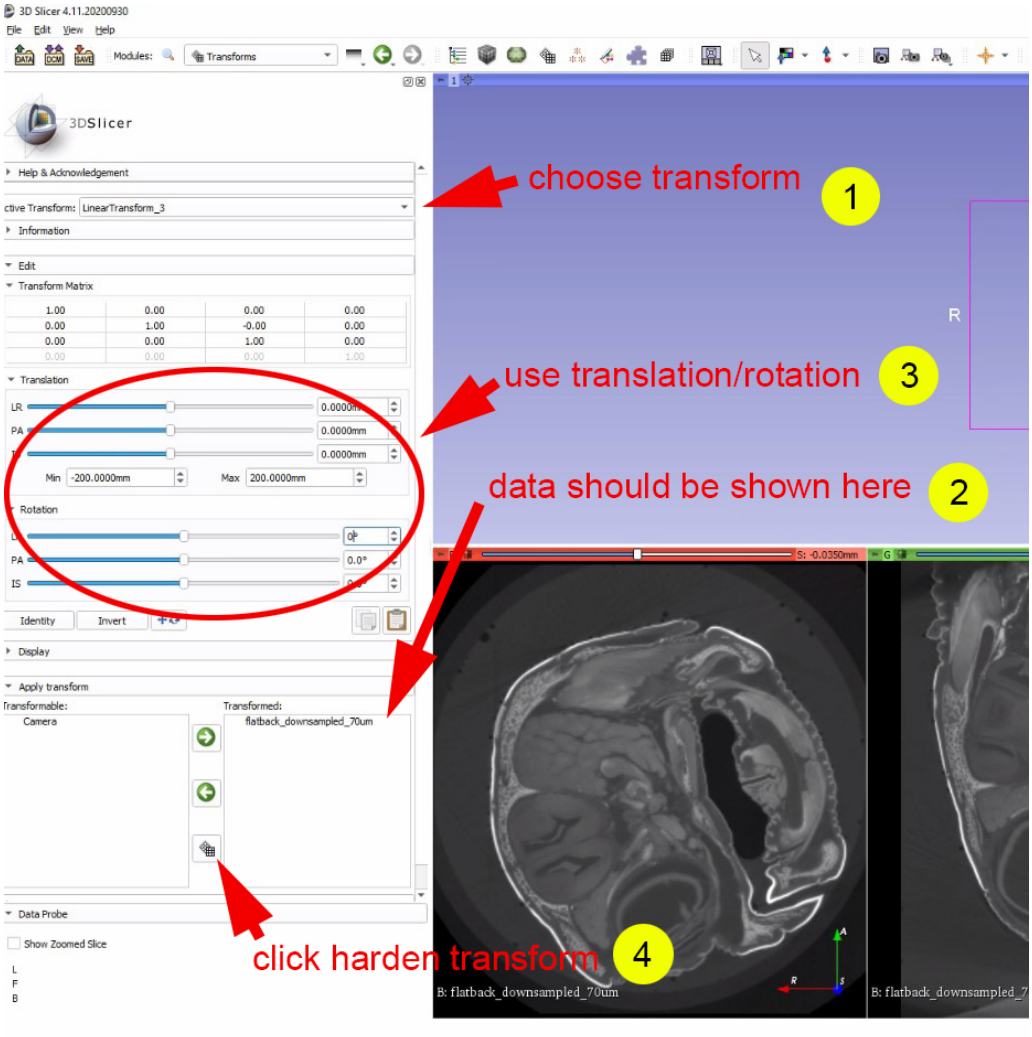
5. Subject hierarchy (Tab) > right click transform column of data > select the “linear transform”.



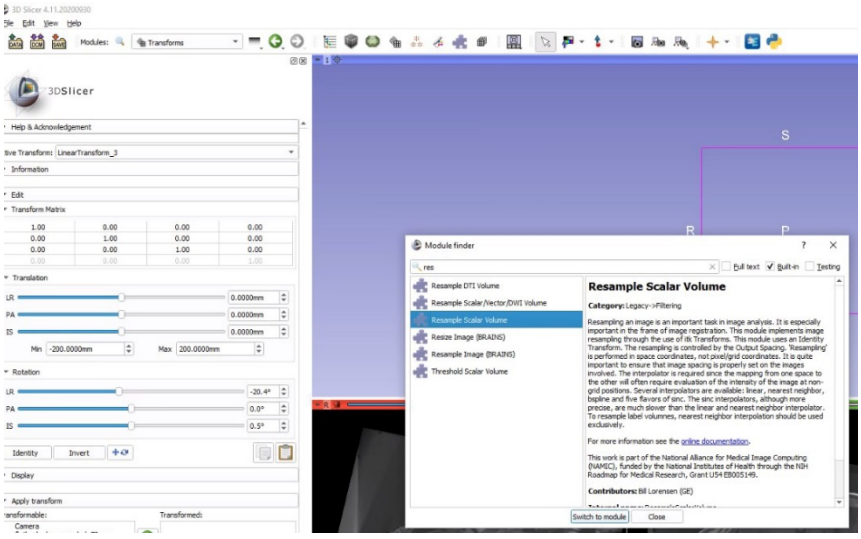
6. Modules menu > Transforms



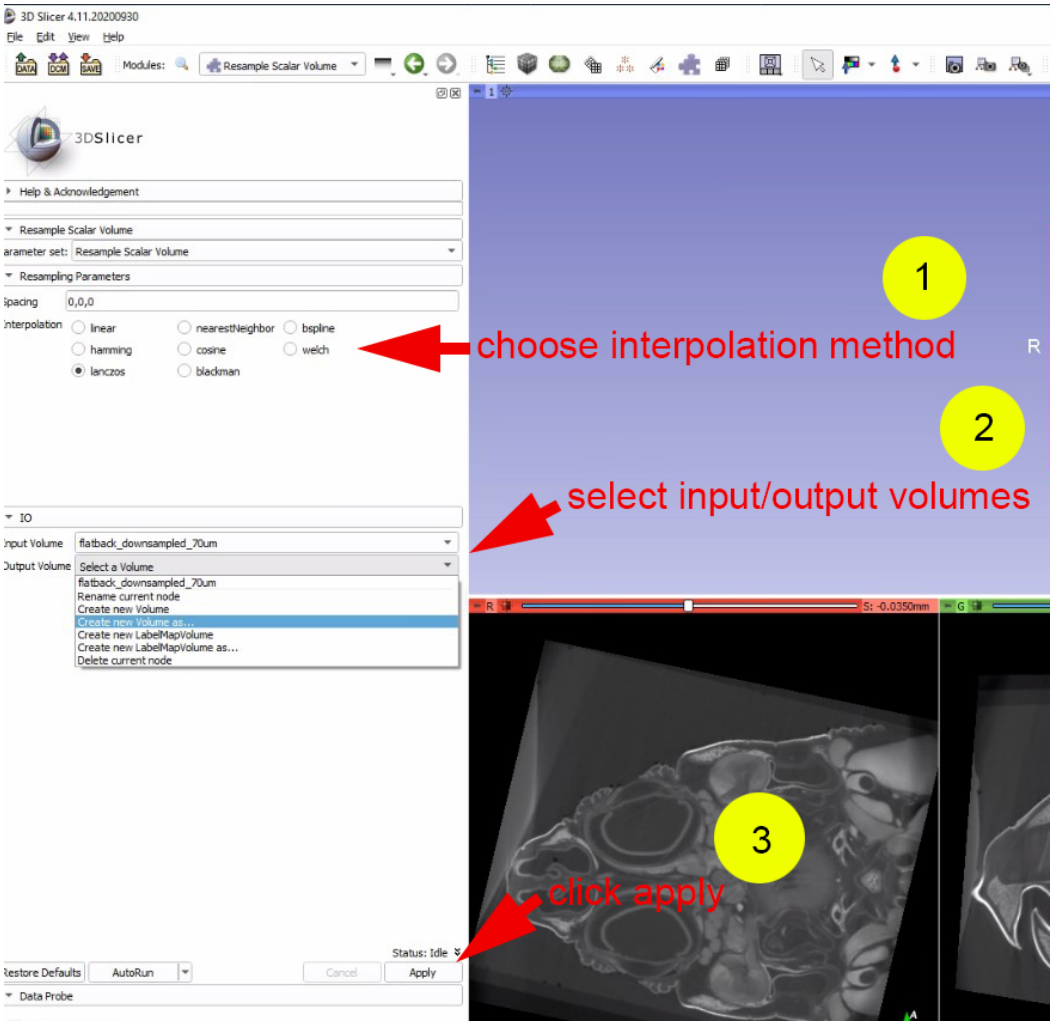
7. Ensure the relevant transform is selected in the “Active Transform” list. Data should be shown in the “Transformed” column. Use Translation and/or Rotation sliders to transform the slices to the desired orientation. When finished, click the “Harden Transform” icon.



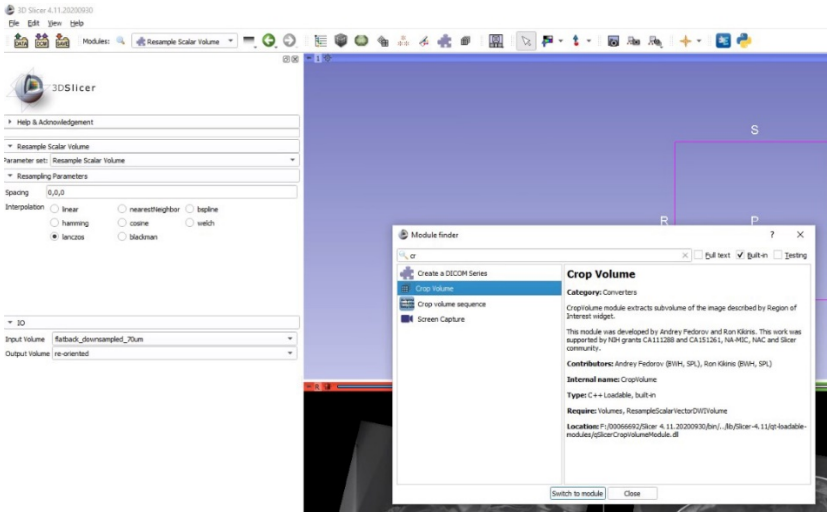
8. Modules > Resample Scalar Volume (Note: all Modules can be searched for using the “Module finder”. Frequently used modules can be added to the toolbar using the application settings in the Edit menu.

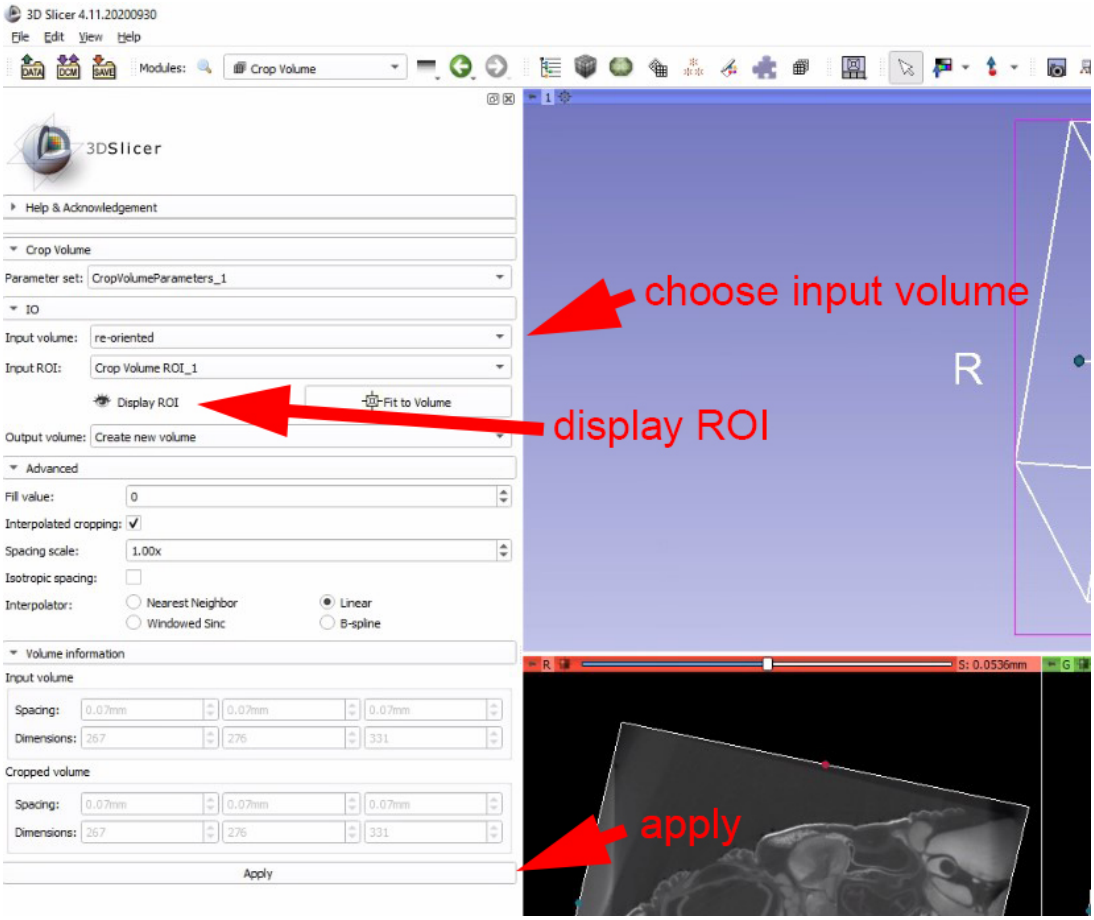


9. Choose a relevant interpolation method then select the Input and Output volumes. When finished click “Apply” (Note: this may take some time depending on the size of the volume).

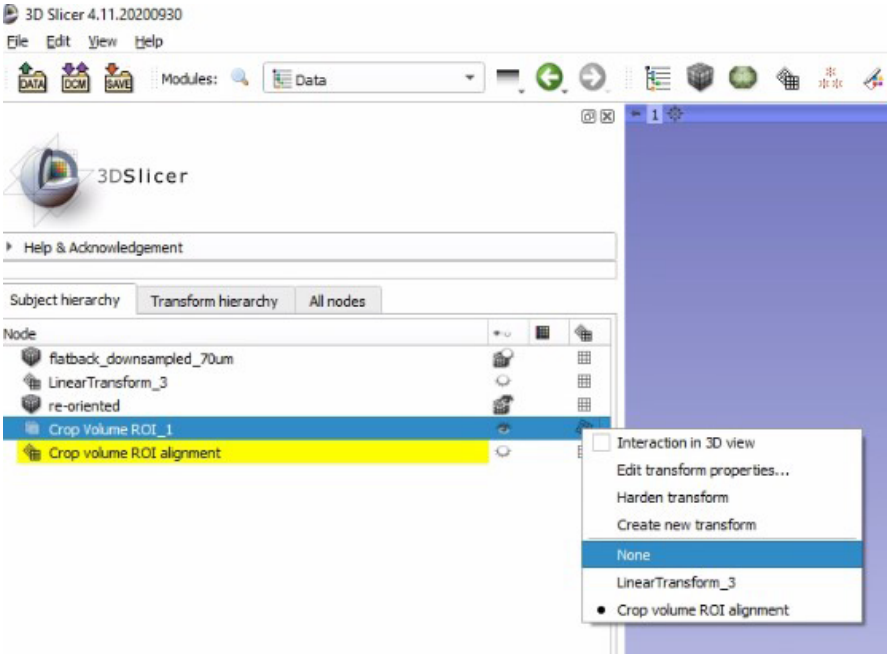


10. Modules > Crop Volume (Optional) Ensure your re-oriented volume is selected in the “Input Volume” menu. Ensure the “Display ROI” icon is active.

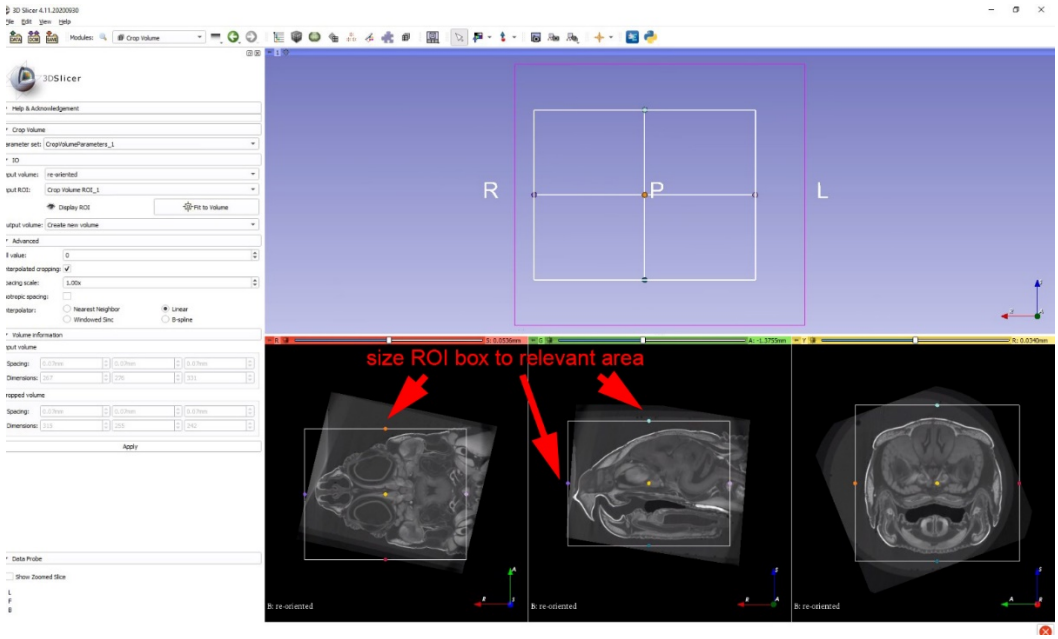




11. If the ROI is off axis (as shown above, bottom right), return to the Data module and select "None" for the relevant "Crop Volume ROI" in the Subject hierarchy by right clicking on the transform column. The ROI position will reset.



12. Use the coloured markers of the ROI box to resize the crop box to the relevant area of your sample. When finished, click “Apply”.



13. Finally save any relevant data from the scene.