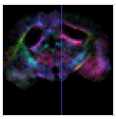

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Creating Diffusion Tensor Images (DTI)

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ABSTRACT

This procedure describes the steps required to create diffusion tensor images (DTI) from data from the MRI scanner.

The following programs are required to go through the protocol:

- MRtrix3
- TORTOISE
- ITKsnap

Note: If you are working from a Windows computer, you will need to follow X2Go Client Set-Up (dx.doi.org/10.17504/protocols.io.6tvhen6) before you can begin this protocol.

Set Up Directory with Required Files

1 Open a new terminal.

2 Confirm what directory you are currently in.

pwd

pwd

0-58-generic #64-Ubuntu SMP

3 Create a directory to place data. *(If not already created.)*

mkdir

mkdir ~/Data/Projects/

Create directory.

0-58-generic #64-Ubuntu SMP

4 Go to the directory that you plan to use.

cd

cd

Go to a specified directory.

0-58-generic #64-Ubuntu SMP

5 Copy directory where your raw data files that will be acquistioned, reside in.
You will need the following file types:

- Bvals
- Bvecs
- data.img
- data.hdr* - (*may not need this in all cases - used for FOV origin)*

5.1 Find where the files you plan to copy are located. *Make sure to use the original root i.e /home/... as you will get an error if you start from another location.*

ls

ls

To list files in a specific directory.

0-58-generic #64-Ubuntu SMP

5.2 Copy the specific files that you need. Alternatively, you can use **.** to specify the current directory you are in.

cp

cp

Copy file or entire directory to a specified location.

0-58-generic #64-Ubuntu SMP

6 Perform conversion between different file types.

mrconvert

mrconvert

MRtrix3

7 Import data from nifti format to TORTOISE list file format. A new directory will be created and the folder will be labeled **____proc**. Example:

ImportNIFTI

ImportNIFTI

TORTOISE

8 Go to the new directory that was created from the previous step.

9 Correct motion. Use **DIFFPREP** command. (*This is a command from TOROISE*). ***Note: This step is time & core consuming. Also, this step removes Gibbs ringing and noise***

DIFFPREP

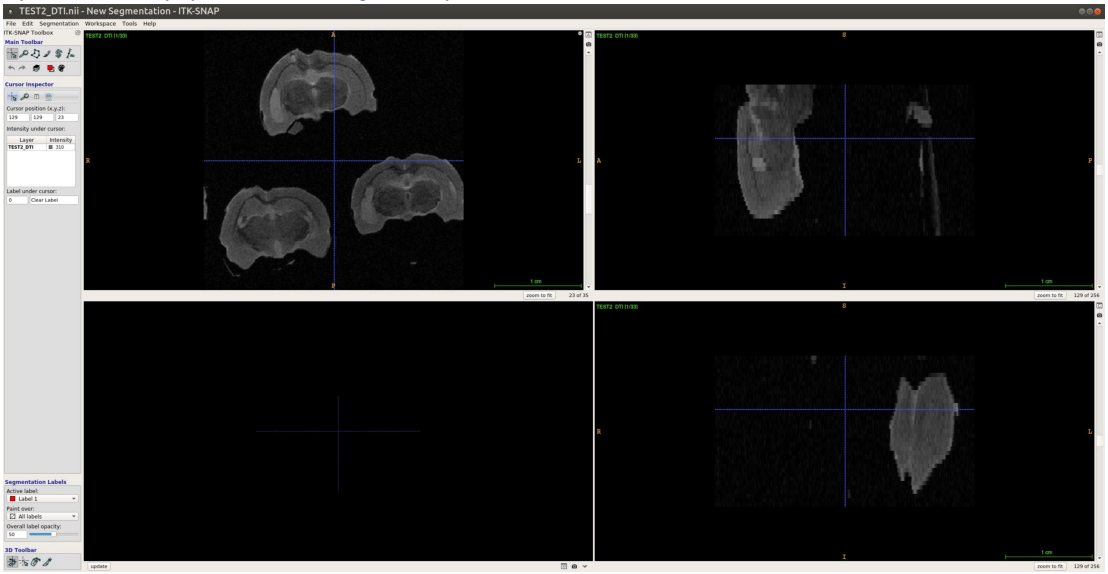
DIFFPREP

Corrects motion.

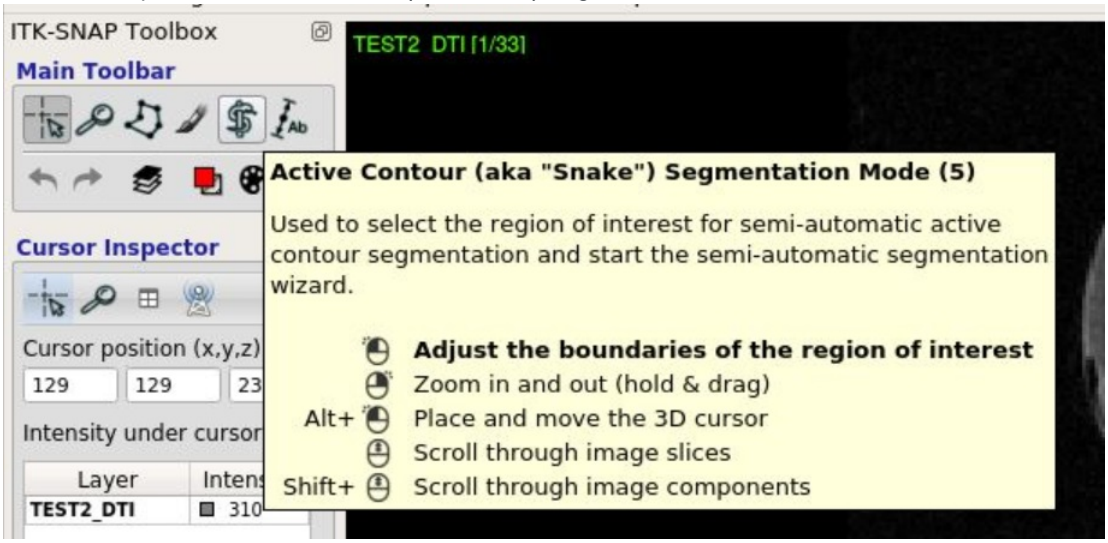
TORTOISE

Create Mask and Segmentation

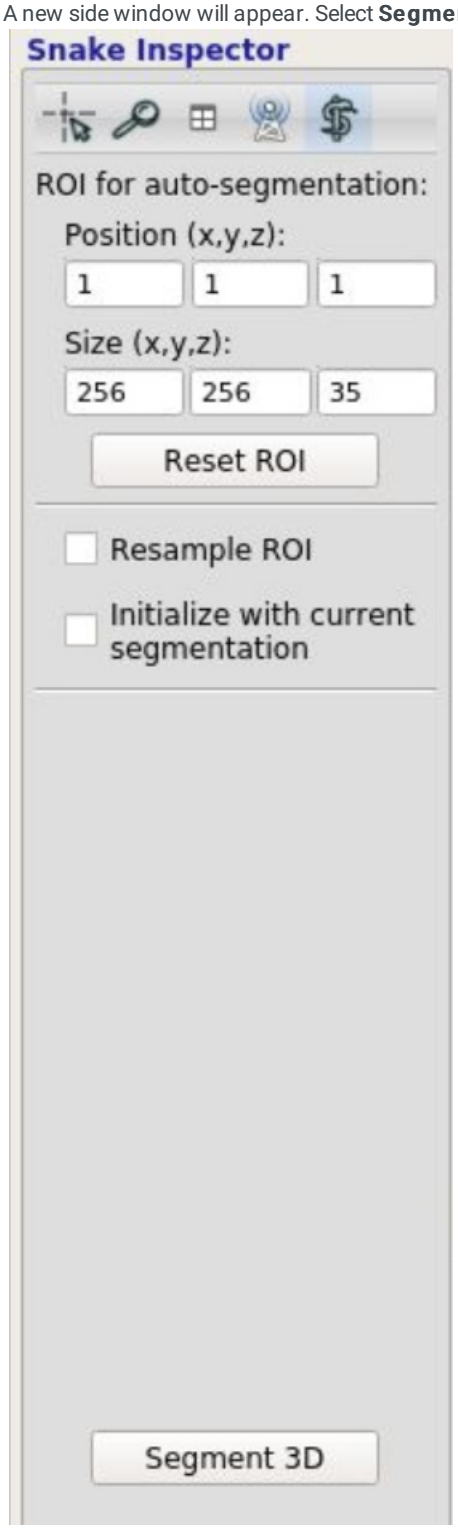
10 Open one of the populated files using ITKsnap.



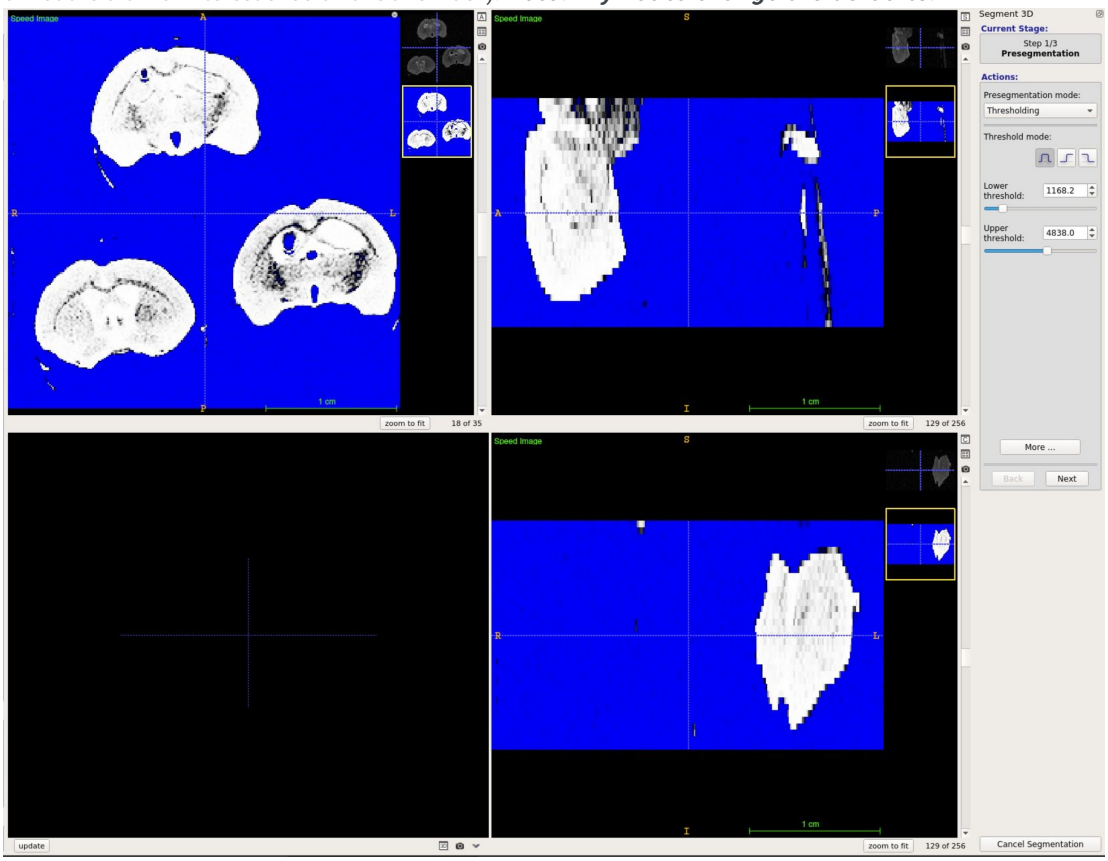
11 Within ITKsnap, select **Active Contour (aka Snake) Segmentation Mode** from the toolbar.



12 A new side window will appear. Select **Segment 3D**.



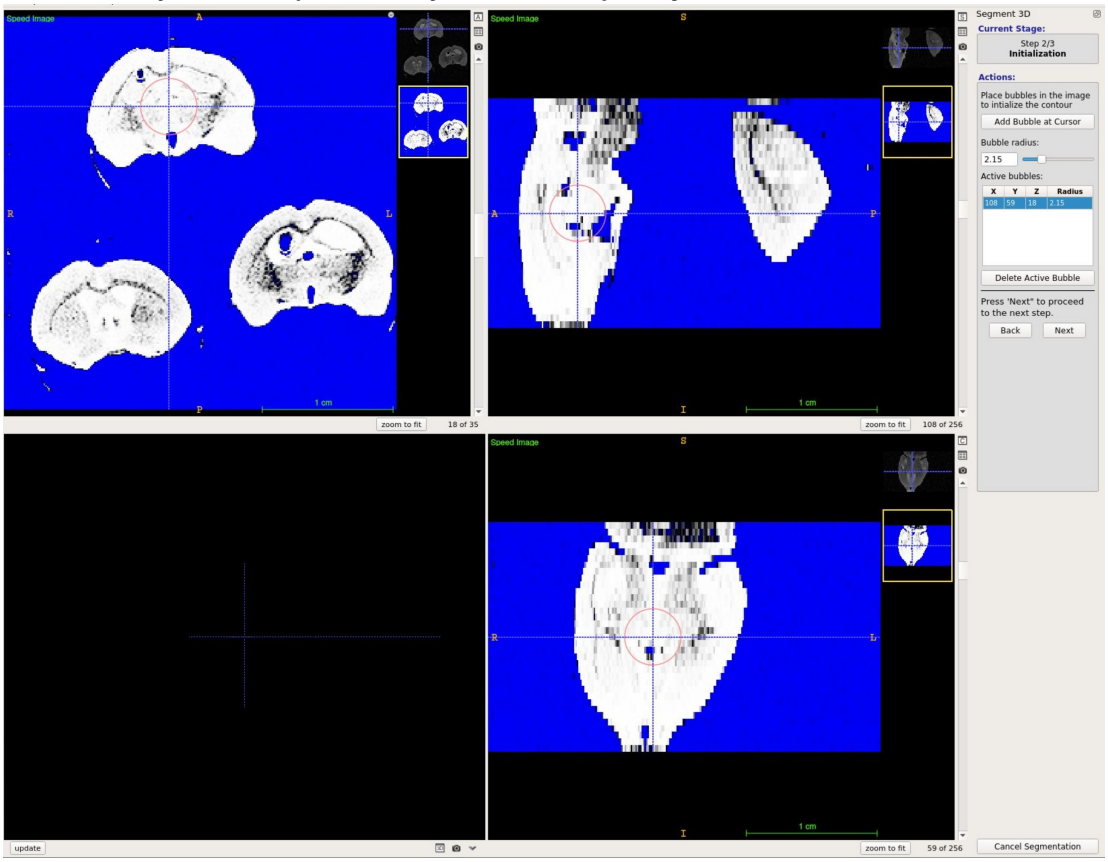
13 Toggle the thresholds (lower & upper) so that the blue mask covers the region you want repelled. (*Regions that are empty space or not the brain of interest should have this mask*). ***Note: Try not to change the defaults.***



14 When the thresholds have been finalized, select **Next**.

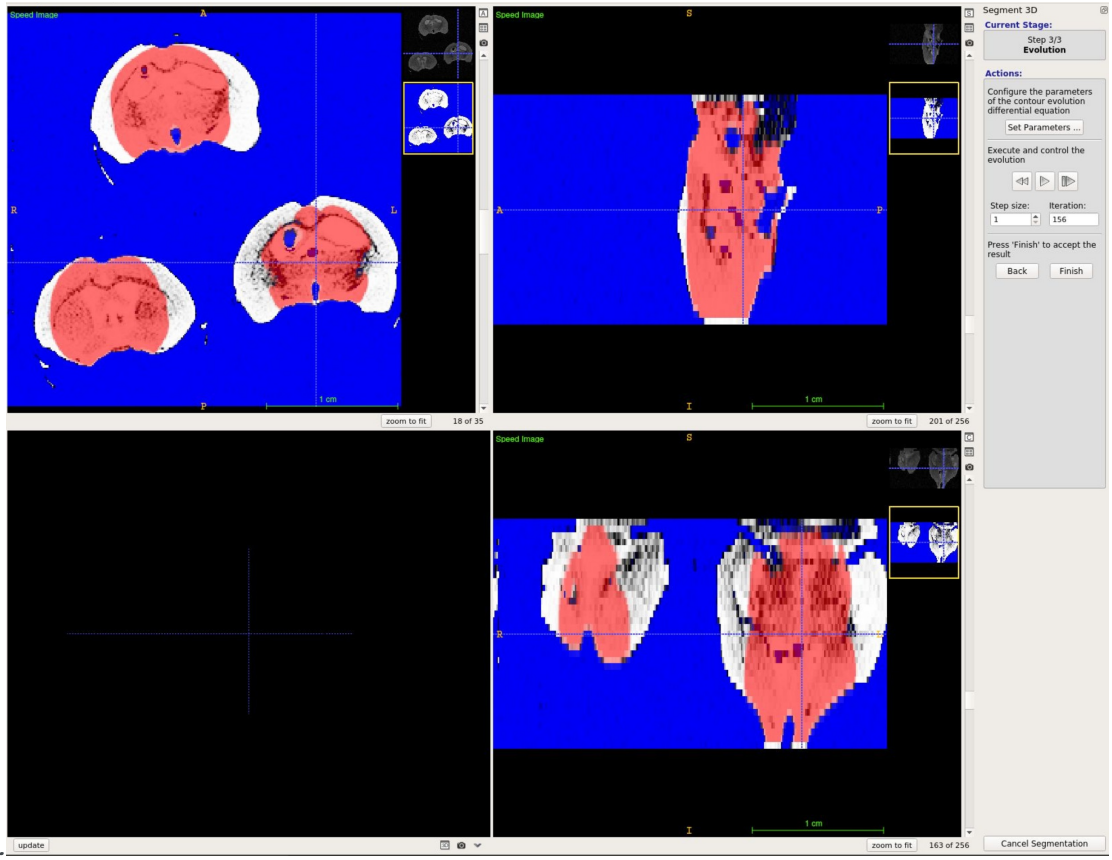
15 Set the cursor in the relative center of your object of interest. Select **Add bubble at cursor**. A red circle(seed/bubble) will be placed at the location.

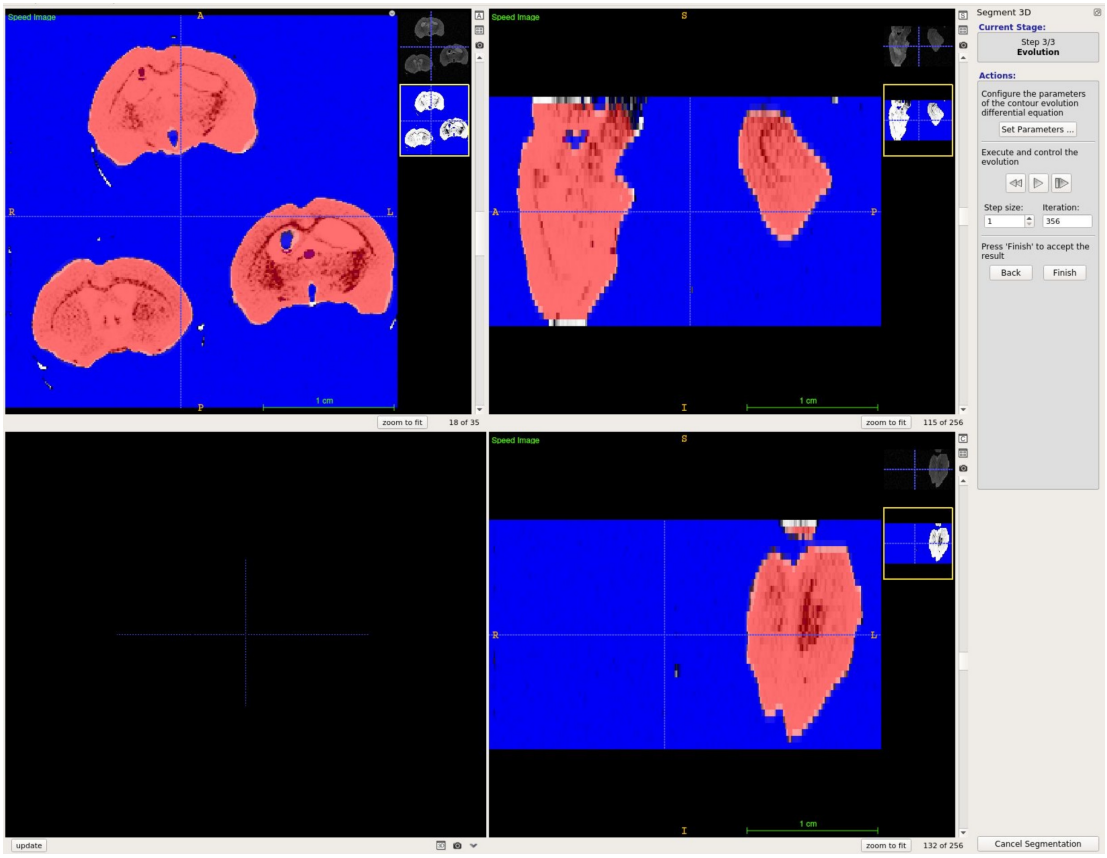
Note: You may need to repeat this if you have multiple objects of interest.



16 When the bubbles have been set and you have no more to add, select **Next**.

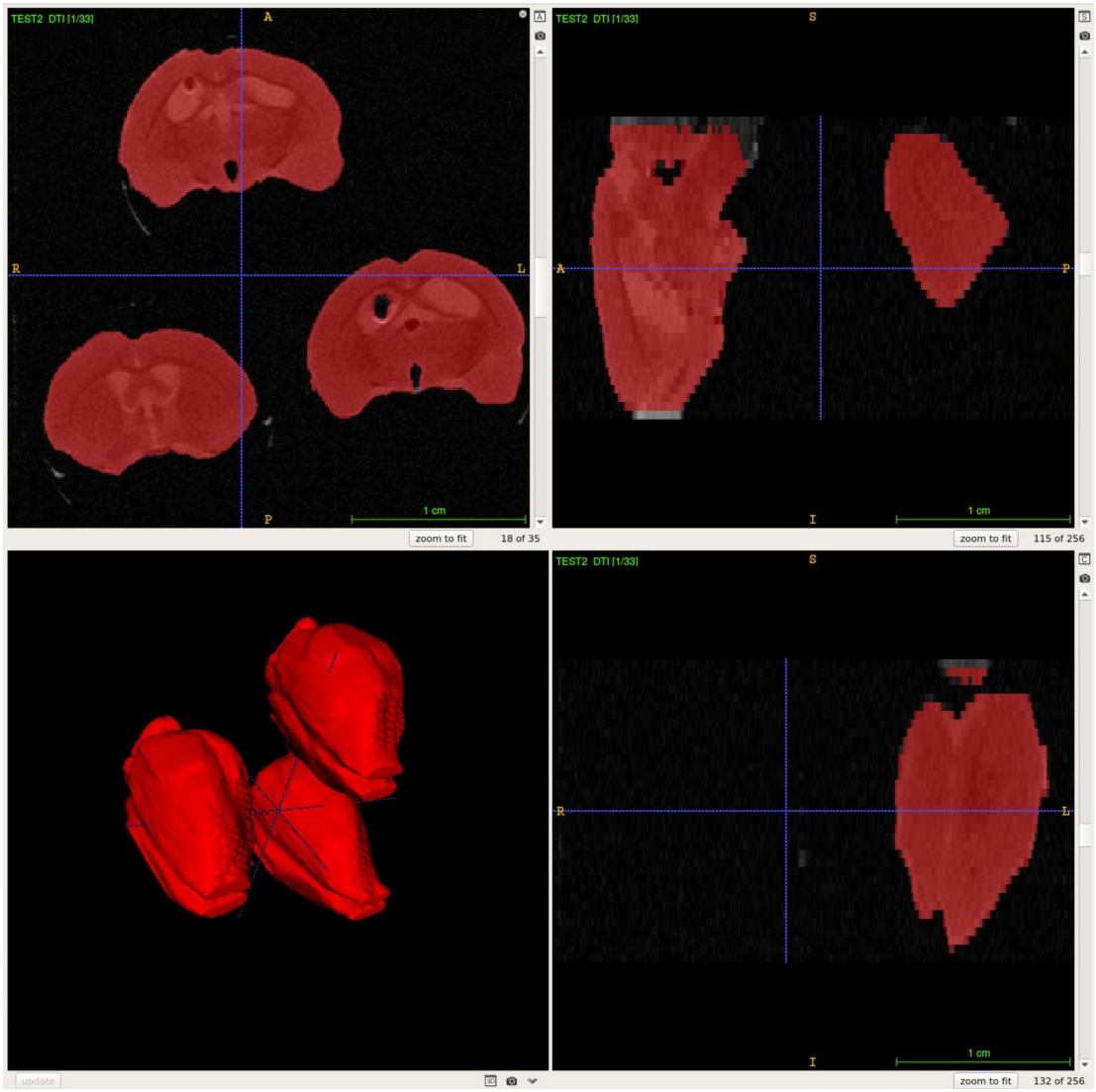
17 Press the play buton to have the seed grow within the mask that was set-up in a previous step. ***Note: Red should propagate and fill the entire region(s) of interest. This may require viewing the images from the different planes to confirm.***



18 

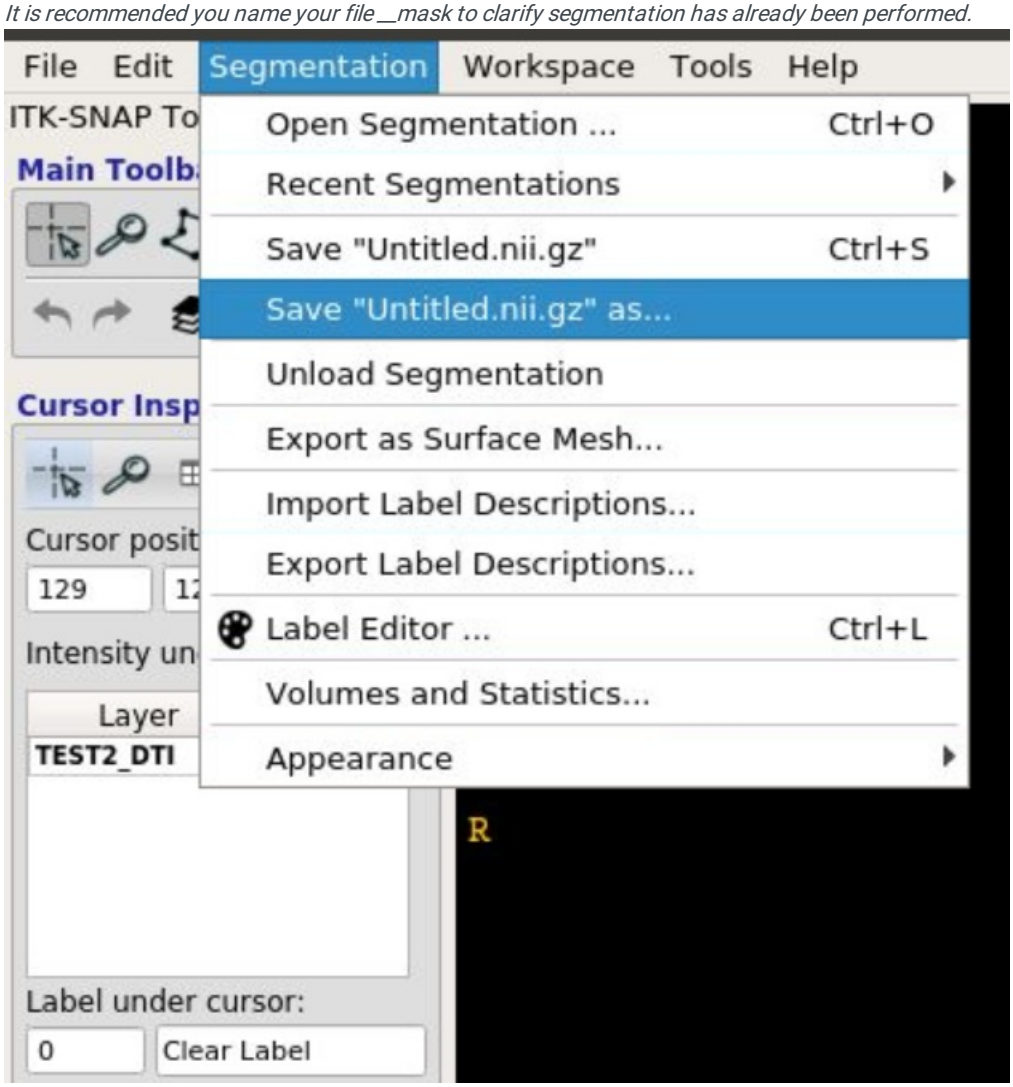
Once the region(s) of interest are completely filled, select **Finish**.

19 Press **Update** in the lower left corner of the ITKsnap interface to view the new 3D segmentation image.



20 Select **Segmentation** and **Save As** from the drop-down menu. You will be prompted to save your file as a **__.nii.gz** file type.

It is recommended you name your file __mask to clarify segmentation has already been performed.



21 Close out of ITKsnap.

22 In an open terminal, unzip the **___.nii.gz** file that was segmented in the previous step.

gunzip

gunzip ___.nii.gz

Unzip file(s) of interest.

23 Estimate diffusion tensor and Bo amplitude.

EstimateTensorNLLS

EstimateTensorNLLS -i ___DTI_DMC.list -m ___mask.nii

Generates diffusion tensor and B0 amplitude.

TORTOISE

This command will generate 2 files:

- **___N1_DT.nii** (diffusion tensor)
- **___DT_AM.nii** (B0 amplitude)

24 Compute all tensor maps on the **___N1_DTI.nii** output file from the previous step.

ComputeAllTensorMaps.bash

ComputeAllTensorMaps.bash ___N1_DT.nii

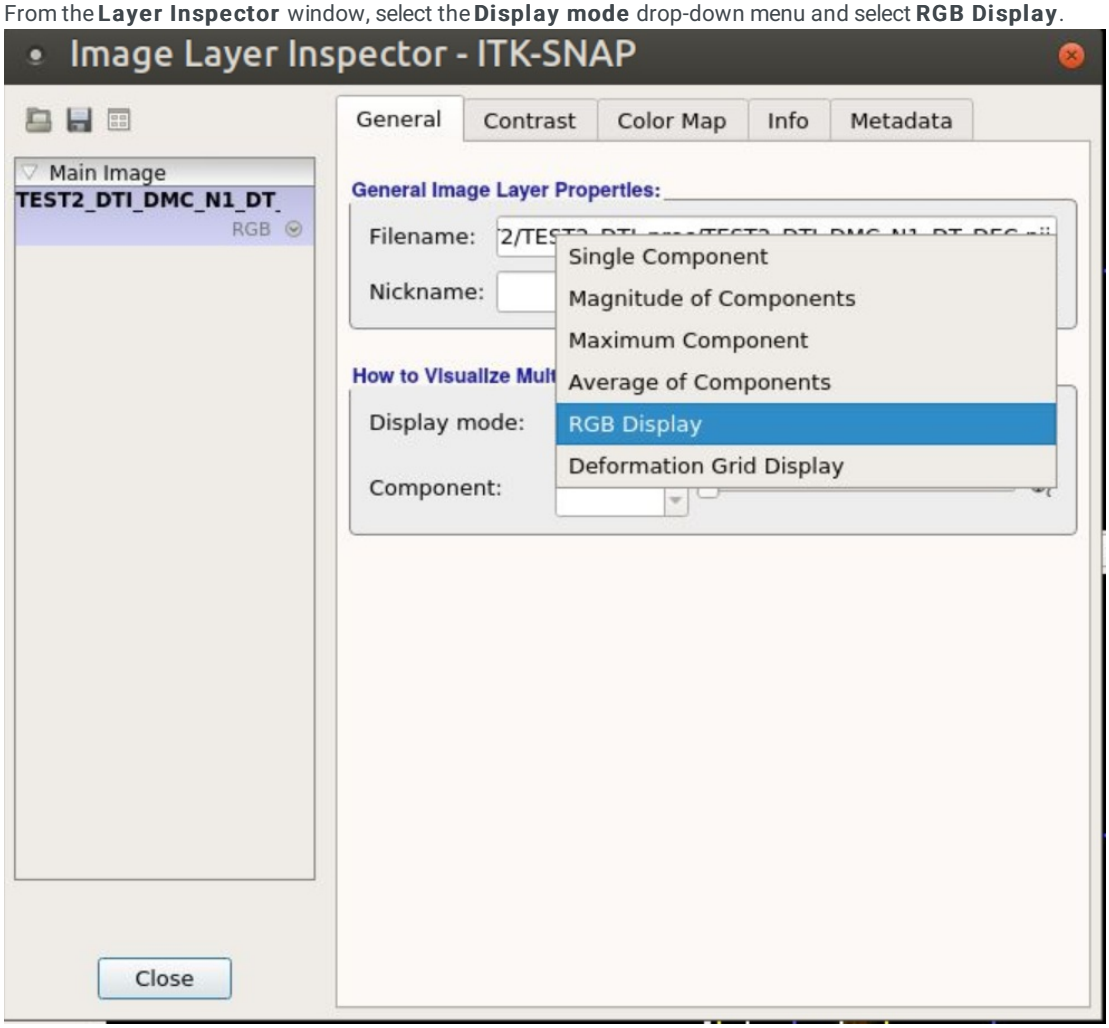
Computer all tensor maps.

TORTOISE

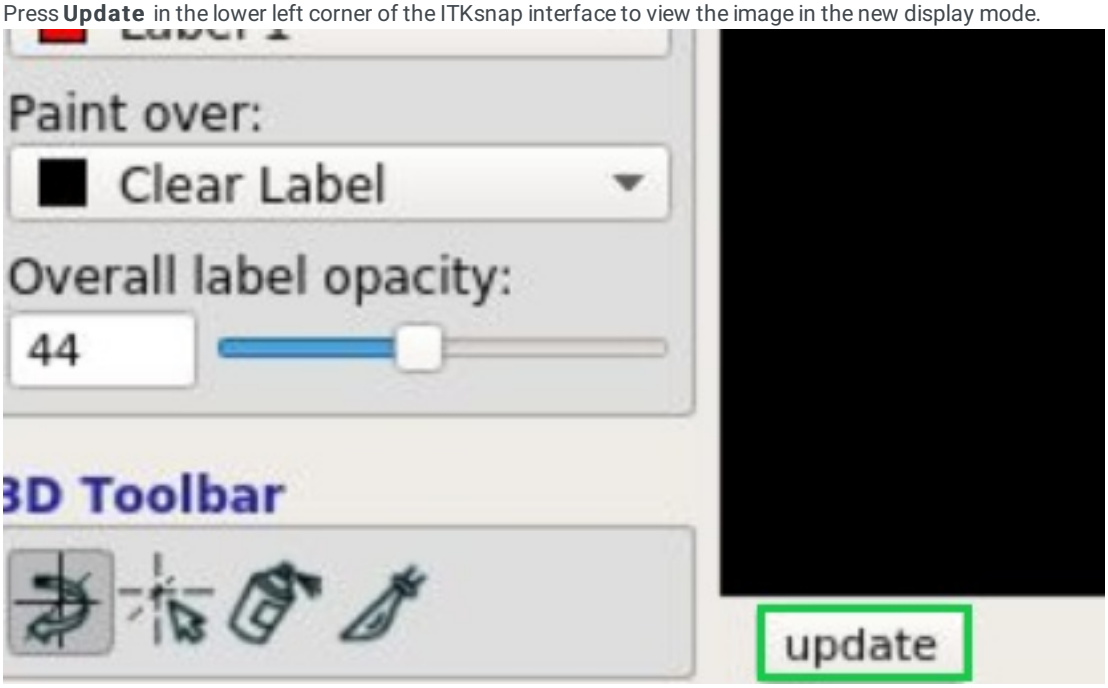
25 Open the **___DEC.nii** output file in ITKsnap to view the primary eigenvector map.

26 Within ITKsnap, select **Layer Inspector**.

27 From the **Layer Inspector** window, select the **Display mode** drop-down menu and select **RGB Display**.



28 Press **Update** in the lower left corner of the ITKsnap interface to view the image in the new display mode.



29 The final result will show a colorized image of your region of interest that allows a visual guide that estimates location, orientation, and anisotropy of the brain's white matter tracts based on the diffusion of water molecules.