Diffusion Tensor Imaging (DTI)

The Analyze MR Diffusion Tensor Imaging add-on computes and saves the primary diffusion maps from diffusion-encoded MRI data. The module also provides standard visualizations of DTI data and includes white fiber tracking and visualization (Tractography). This protocol will demonstrate how to compute DTI maps as well as compute and display fibers.

Loading DTI data and Computing DTI Maps

1. To load in a series of DTI data open the **DICOM Tool** (**File > DICOM Tool**), then import the DICOM images (**File > Import Dicom Images**). Navigate to the folder containing the DTI data, and click **OK**. A dialogue window will be returned asking if you would like to import all DICOM files found below that directory, click **Yes**.

2. Select all the DTI files and click **Load Volume**. In the dialogue window returned, select **Create a 4D Multivolume**.

3. Once the volumes are loaded into the workspace, select the appended multivolume (Figure 1).

4. Open the **DTI** module (**Apps > DTI**), the module will open to the **Config** tab (figure 2).

5. Analyze will attempt to automatically load the gradient directions. If the gradient directions are not automatically loaded, click the **Load Gradient Directions** button and select a text file with the gradient directions already logged.

6. The data may require a flip along an axis.

7. Select the **Map Processing** tab.

8. Set a threshold so the background noise is set to white, any voxels displayed in white will not have map values computed (figure 3). Click **Compute DTI Maps**.
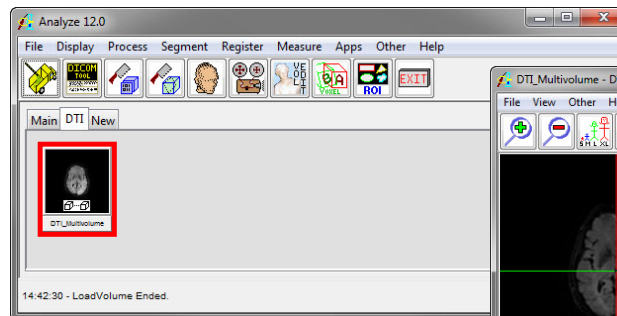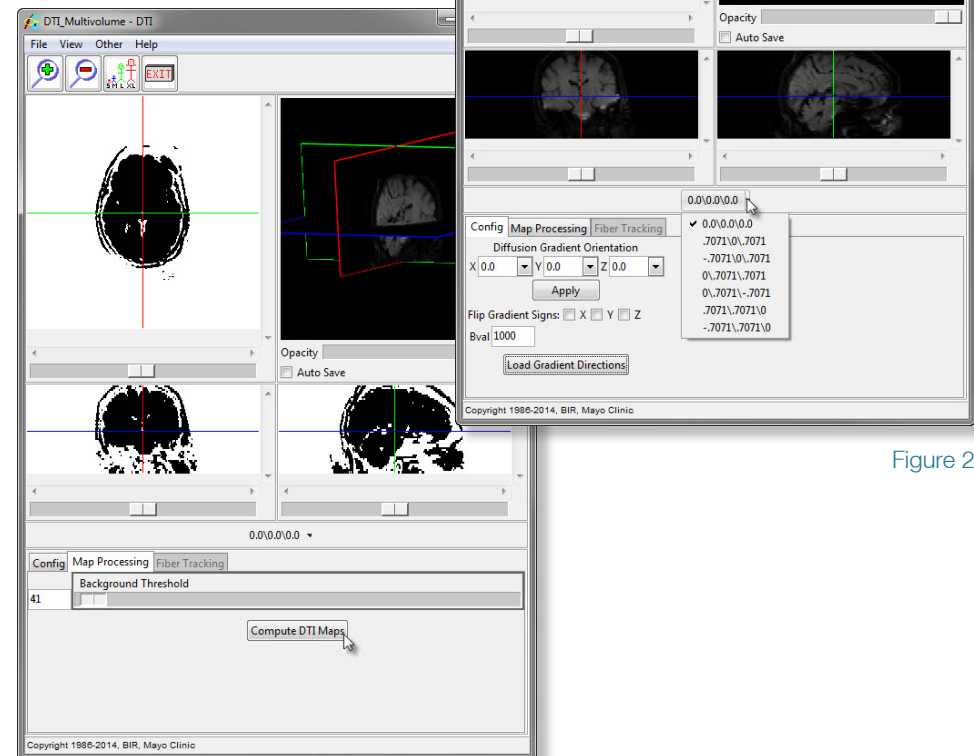

Figure 1

Figure 2

Figure 3

AnalyzeDirect

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9. After the DTI Maps have been computed, select **File > Save DTI Maps**. In the window returned, set the **Destination** to **Analyze Workspace** and click **Save Volume**.

10. All the DTI Maps will be output to the Analyze workspace.

11. To define a region of interest, select the **FA** map and the **EVCM**. Open the **Region of Interest** module (**Measure > Region of Interest**).

12. By moving the slice slider bar, select a slice that contains a region of interest. In this example, we will define the corpus callosum.

13. To begin defining, select the **Auto Trace** tool and set a seed point within the corpus callosum. A doubled ended threshold bar will be returned in the ROI window.

14. For this example, we set the **Minimum Threshold** to **143** and a **Maximum Threshold** of **237**. Click **Apply** to define this trace as an object.

15. Next, we will move to the next slice and set another object for the corpus callosum. Click to set a seed point within the region, and the threshold previously set should be automatically populated.

16. Click **Apply** to create a second object.

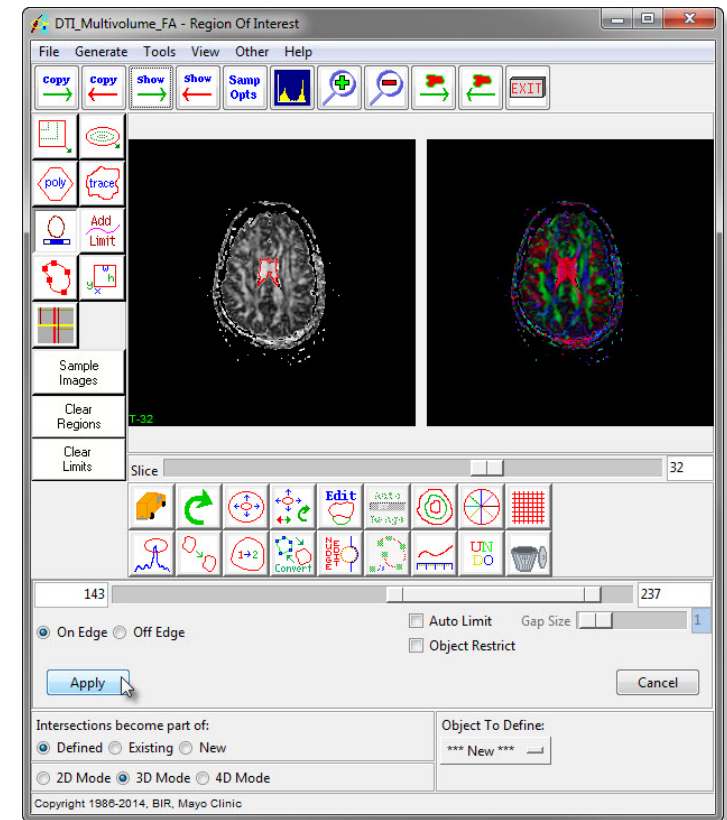17. Now that there are multiple objects defined, save the object map (**File > Save Object Map**).

Figure 4

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18. Return to the DTI module and click on the **Fiber Tracking** tab. Click the **Load Object Map** button. Select the object map from the last section, and click **Open**. The two objects defined in the last section will be displayed.

19. Click the **Compute Fibers** button. Once the computation is complete, click the **Display Fibers** button.

20. In the display window, the fiber bundles are displayed (figure 5). You will see the fibers displayed in the object color they were assigned in the Region of Interest module. To zoom in or out on fiber bundles, hold the middle mouse button while moving the mouse forwards and backwards.

21. To rotate the fiber bundles, hold the left mouse button and move in the direction you wish to rotate.

22. To move the bundles within the window, hold the right mouse button and drag the bundles around the window.

23. To change the opacity of the image data, use the **Opacity** slider bar just below the window containing the fiber bundles.

24. Now under the **Boolean Operator**, select **AND**. Click **Display Fibers**. This operation will just show the fibers that are connected to Object 1 AND Object 2. The metrics of these fibers can be logged by clicking **Log Displayed Fiber Metrics**.

25. You can save these metrics out by clicking **Save** in the window returned. These metrics can then be imported into an excel spreadsheet.
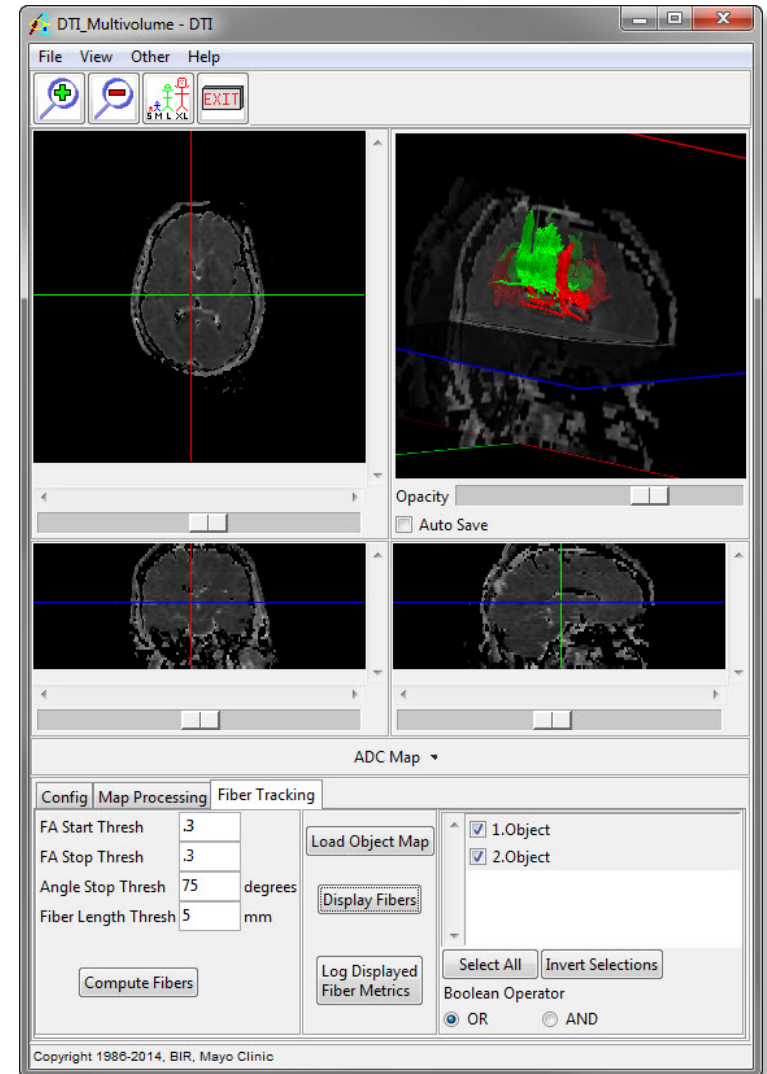

Figure 5