

DIFFUSION TENSOR IMAGING ANALYSIS

Using Analyze





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Introduction

The Diffusion Tensor Imaging (DTI) add-on provides the ability to compute and save primary diffusion maps from diffusion-weighted MRI. The DTI add-on also provides the ability to compute fiber tracts and allows for the direct visualization of fibers either globally or in conjunction with specific anatomical regions of interest.

The primary diffusion maps computed by the DTI add-on include maps for the apparent diffusion coefficient (ADC), relative anisotropy (RA), fractional anisotropy (FA), volume ratio (VR), axial diffusivity, and radial diffusivity. An eigenvector color map (EVCN) is also generated which indicates the principle direction of diffusion tensor at each voxel using color.

This guide will demonstrate how to generate diffusion maps and fiber tracts using Analyze.

Loading DTI Data

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**. Click **Yes** in the the dialog box returned to import all DICOM files found below that directory.

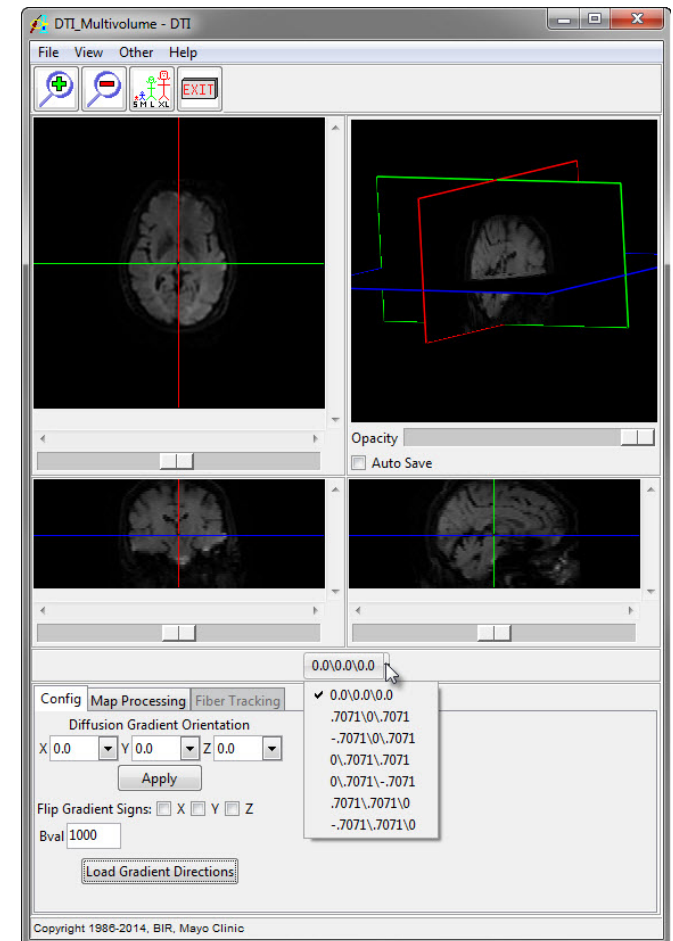
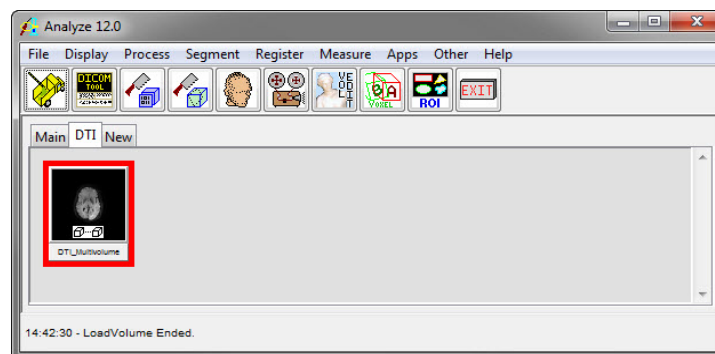
Select all the DTI files and click **Load Volume**. In the dialogue window returned, choose the **Create a 4D Multivolume** option.

Once the volumes are loaded into the workspace, select the appended multivolume.

Open the **DTI** module (**Apps > DTI**). The module will open to the **Config** tab.

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.

Depending on the vendor, the data may require a flip of the gradient signs in the x, y, or z position. This data set was acquired using GE equipment and requires a flip of the gradient signs in the z position.

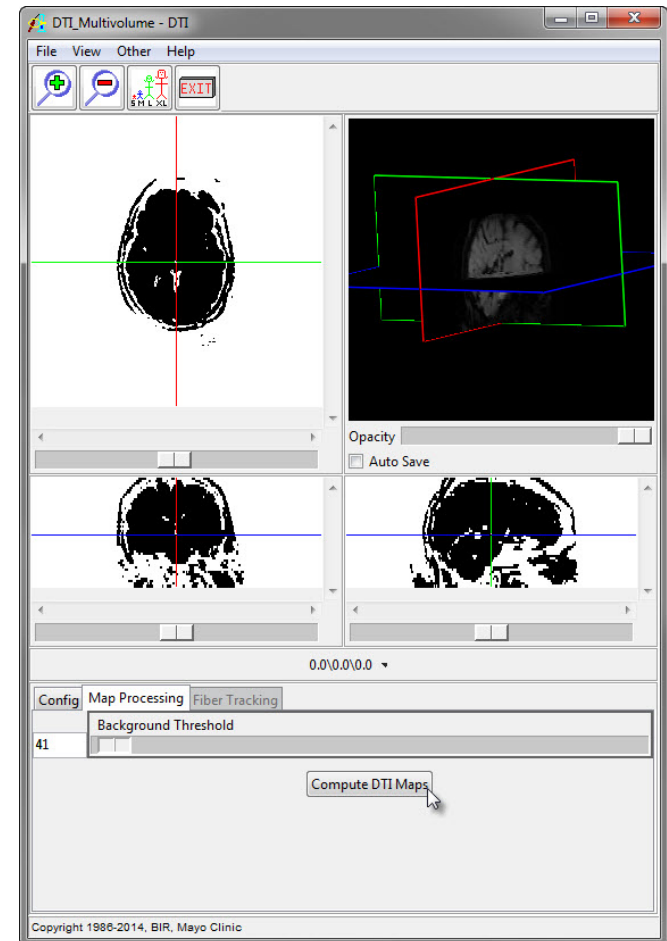


Computing DTI Maps

Select the **Map Processing** tab.

Set a threshold so the background noise is set to white in the binary mask. Any voxels displayed in white will not have map values computed. Click **Compute DTI Maps**.

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**.





Defining ROIs for Fiber Tracking

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

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

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

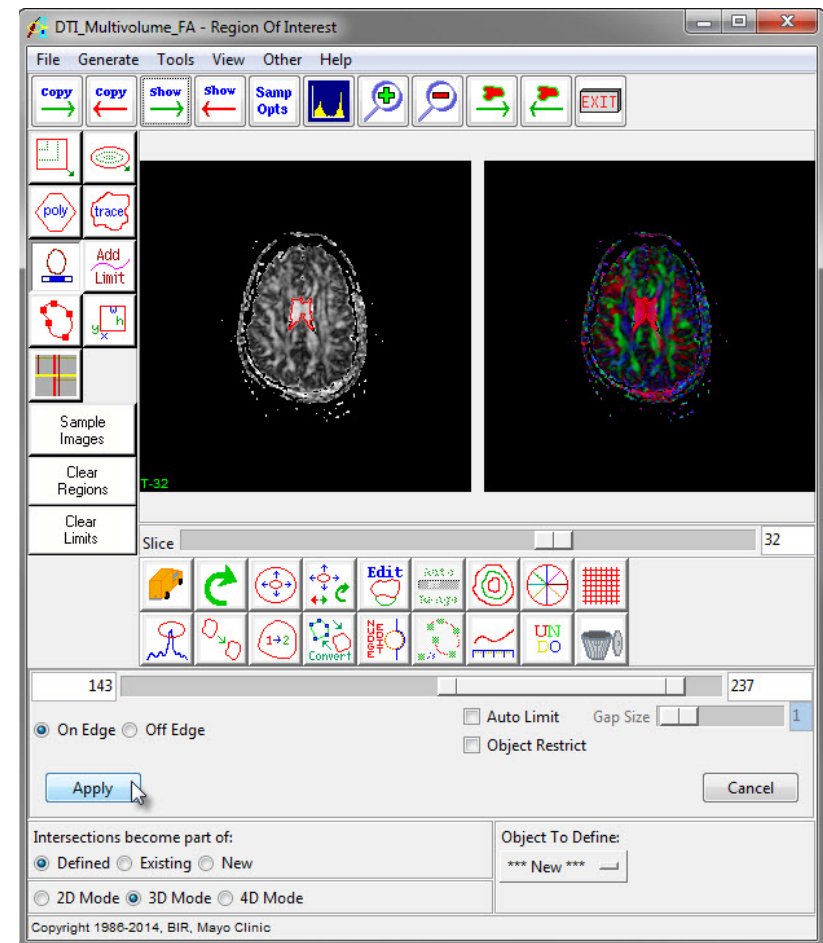
To begin defining, select the **Auto Trace** tool and set a seed point within the corpus callosum. A double-ended threshold bar will be returned in the ROI window.

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

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.

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

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



Visualizing Fiber Tracts

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.

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

In the display window, the fiber bundles are displayed. 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.

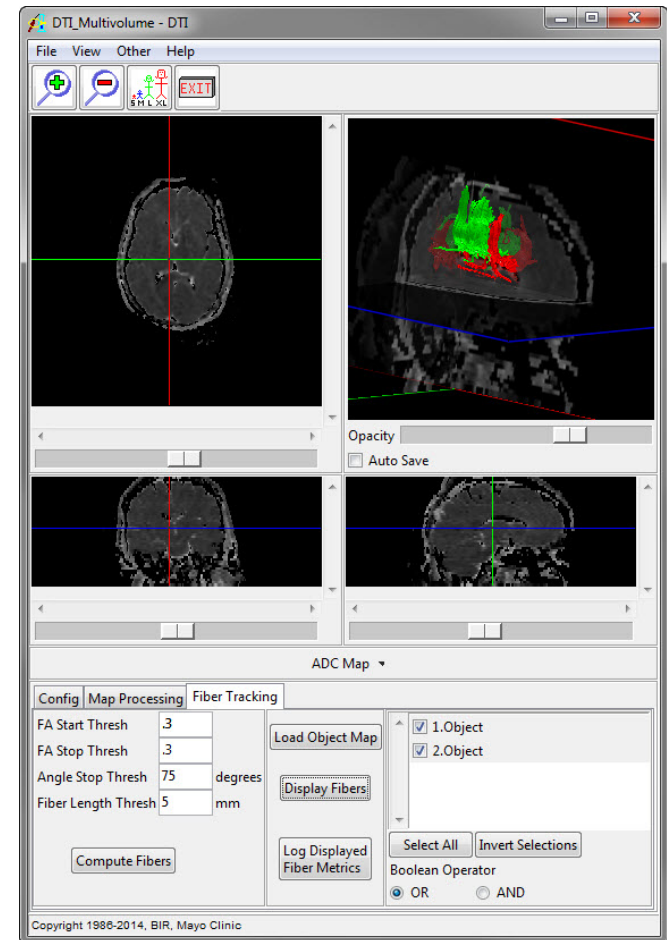
To rotate the fiber bundles, hold the left mouse button and move in the direction you wish to rotate.

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

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

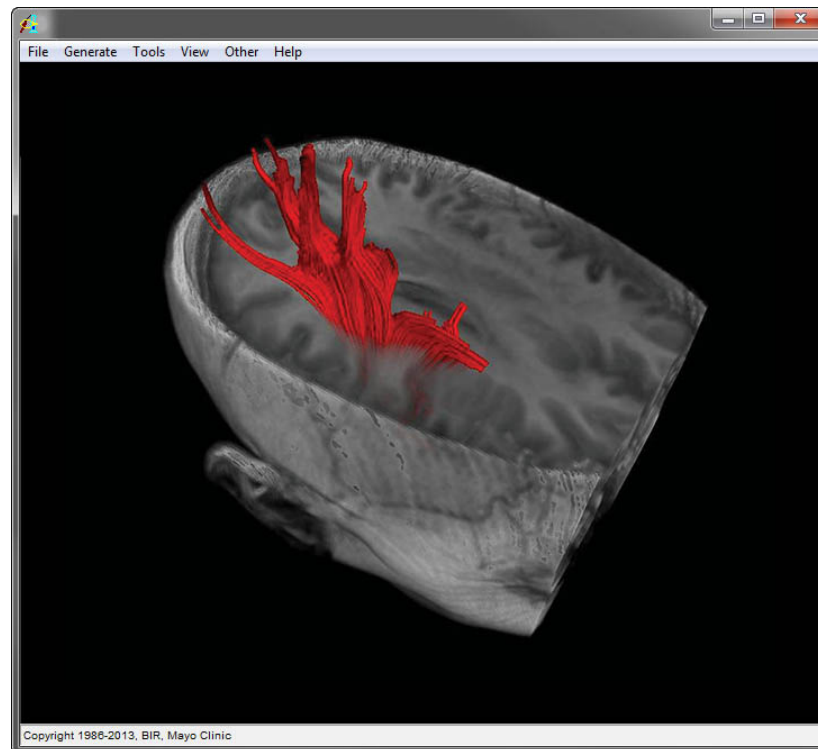
Now under the **Boolean Operator**, select **AND**. Click **Display Fibers**. This operation will just show the fibers that are connected to Object 1 AND Object 2. The metrics of these fibers can be logged by clicking **Log Displayed Fiber Metrics**.

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



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