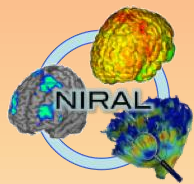


DTI ATLAS FIBER ANALYZER TUTORIAL

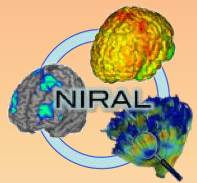
Berger Jean-Baptiste
jean-baptiste.berger@cpe.fr

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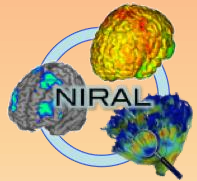
Introduction



Introduction

Main Goals

- Statistical analysis of fibers for different cases
- Visualization of those statistics
- After statisticians processing, merging of statistics with fibers
- Visualization on Slicer



Introduction

Pipeline

DTIAFA

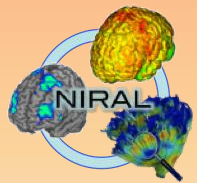
- Generate Statistics
- Plot Statistics

Statistician

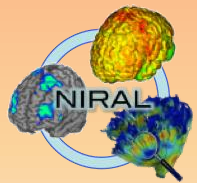
- Clean up statistics

MergeStat

- Merge statistics with fibers
- Viewable on slicer

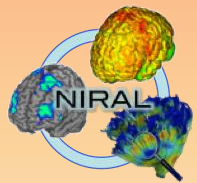


Step 1 : Select your Data



Select your Data

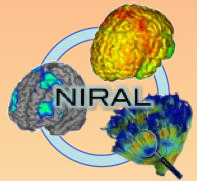
- In this step, you will specify the data which you want to analyze
- Basically, you will specify a .NRRD file and optionally a Deformation Field
- From those files, information will be mapped with an Atlas Fiber



Select your Data

There are 2 different ways to select relevant data :

- Manually thanks to this tools help
- Automatically by opening a data file through the file menu on the top of the window – For more information see “Automated required filling information” beginning at slide 36



Select your Data

Define a CSV File

1- Load an existing .csv file using the browser “...” button

Or

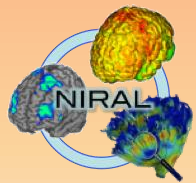
2- Create a new empty table by choosing the number of row and column

3- Modify the current .csv file
You can add a row or a column for the next Id. Or delete a selected row or a selected column

4- Finally Save or Delete the current table

The screenshot displays a web interface with four distinct panels, each highlighted with a colored border and a number:

- Panel 1 (Red border):** Labeled "Load CSV : filename : 1". It contains a text input field with "TI_Tract_Statold/Test.csv" and a grey button with three dots "..." to its right.
- Panel 2 (Blue border):** Labeled "New CSV : 2". It features two vertical sliders: "Number of data" set to 1 and "Number of columns" set to 1. Below these is a grey "Apply" button.
- Panel 3 (Green border):** Labeled "Column : 3". It has a text input field containing "new header". Below it are two grey buttons: "Add Column" and "Delete column".
- Panel 4 (Purple border):** Labeled "4". It contains two grey buttons: "Save CSV" and "Delete CSV".



Select your Data

Define each column

- Select the type of data that will contains each column
- When you enter a number the associated column will be colored as follow :

- Orange for optional case names
- Green for Data
- Blue for optional Deformation Fields

Column with the name of cases (optional) :

(orange color)

Column with the Individual data Images :

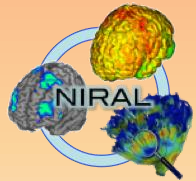
(green color)

Column with the Deformation Field (optional) :

(blue color) H Fields

Displacement Fields

- Select whether you will be using h-fields or displacement fields as deformation fields

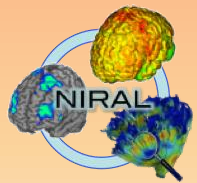


Select your Data

Fill the Table

- Double click on a Data Cell to open a browser and select an image file (.nhdr or .nrrd)
- Double click on a Deformation Cell to open a browser if you want to add a deformation field
- To specify a case name just enter a name in the “Name” column

	1	eformation fie	Name
1	...ampdti.nhdr	...deformation	Test
2	...ampdti.nhdr	...deformation	Test1

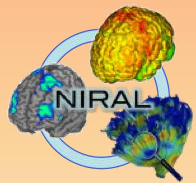
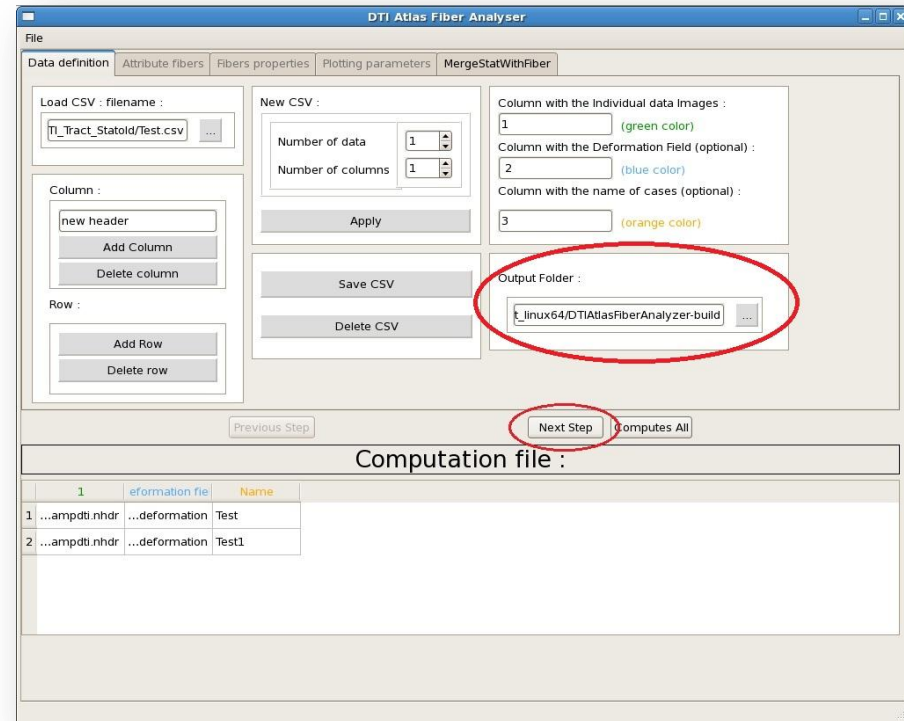


Select your Data

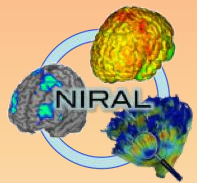
Going to Step 2

- To go to the next step you need to specify an output folder (see Output Hierarchy for more information)
- If there are :
 - A Table
 - A data column specified
 - An output folder

Then you can click on “Next Step” to go to the Step 2

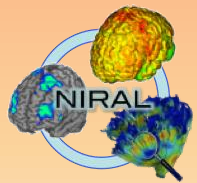


Step 2 : Atlas Settings



Atlas Settings

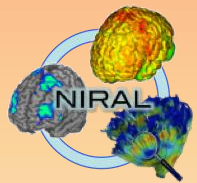
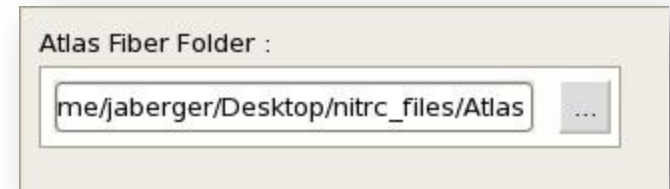
- Here you will choose which Atlas Fiber you want to map your data with
- This step will extract the fiber from the input image
- Then statistical information could be extracted



Atlas Settings

Specify the Atlas Folder

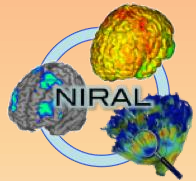
- Click on “...” button to open the browser
- Specify the path to your Atlas Folder
- This tool only support VTK Files or FIB Files



Atlas Settings

Select Fibers to use

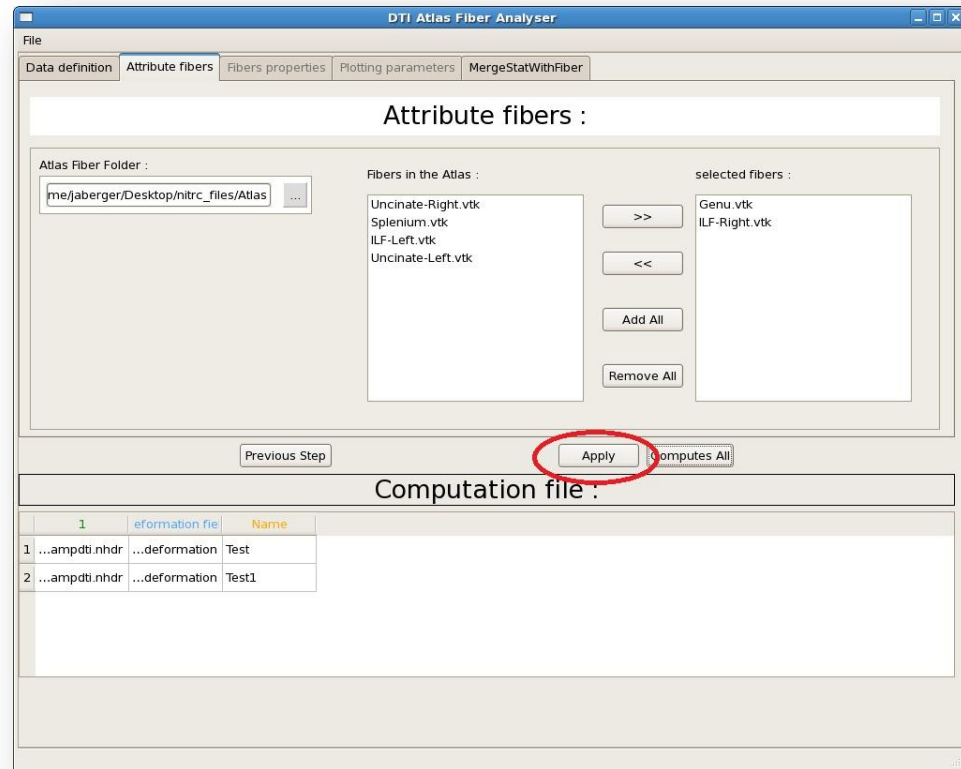
- On the left part you can see every Fibers File read on the Atlas Folder
- The right part contains the fibers that you chose to continue the analysis
- Click on a fiber to select it
- Use “>>” or “<<” buttons to send a selected item to the right or left part.
- “Add All” and “Remove All” will send every fibers from the left to the right and vice versa



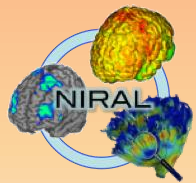
Atlas Settings

Extract Fiber From Volume

- If there is at least one fiber selected, you can click on “Apply”
- “Apply” will process data for each cases and for each selected fibers
- It will create a VTK File for each combination case-fiber named as following : *casename_fibername.vtk*
- You can see created file on the Table



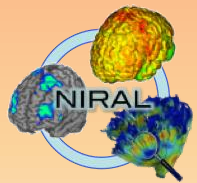
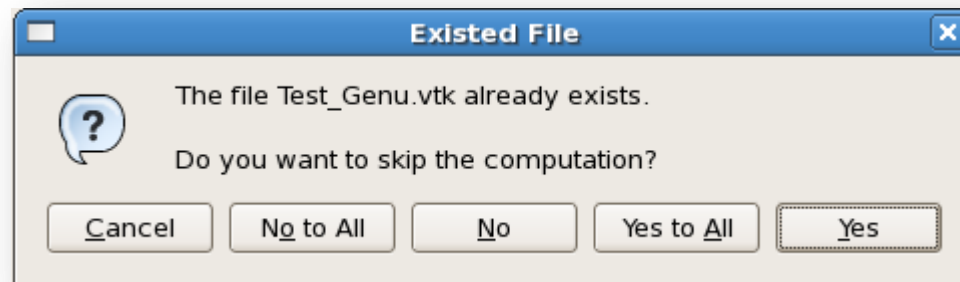
	1	eformation file	Name	Genu.vtk	ILF-Right.vtk
1	...ampdti.nhdr	...deformation	Test	...erAnalyzer-	...erAnalyzer-
2	...ampdti.nhdr	...deformation	Test1	...erAnalyzer-	...erAnalyzer-



Atlas Settings

Skipping computation?

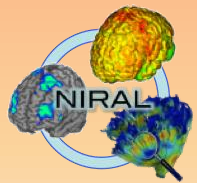
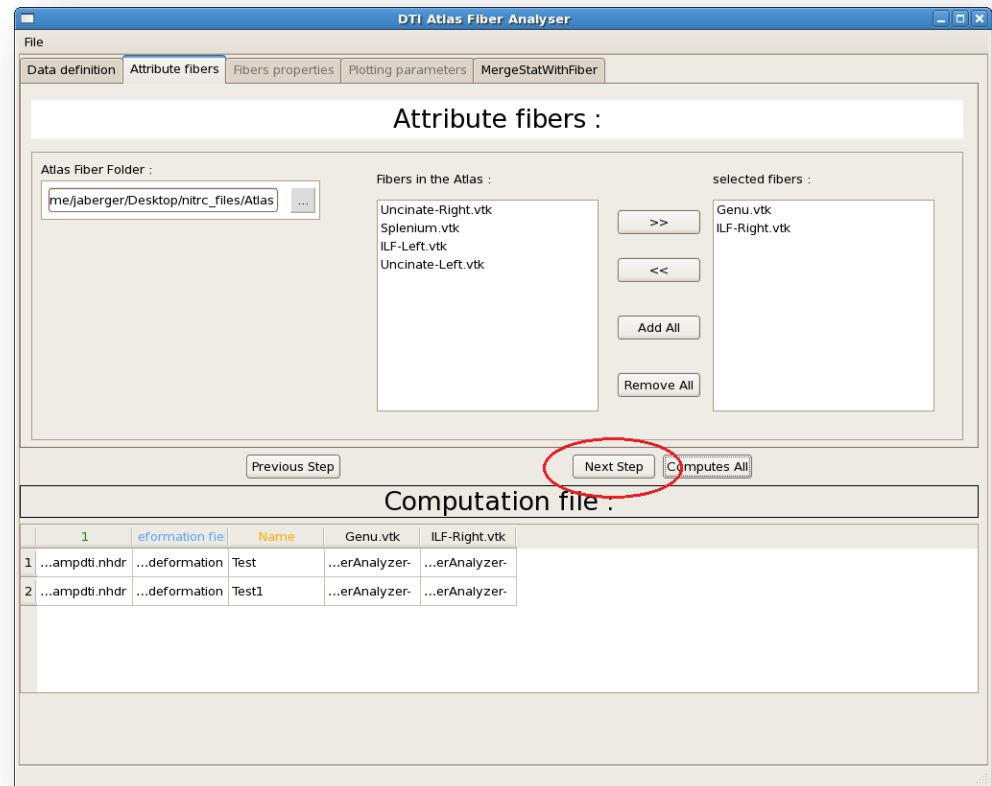
- If a file already exist in the same folder (see Output Hierarchy) a window pop up
- “Cancel” will stop FiberProcess
- “No” and “No to All” will replace the existing file by the computed one(s)
- “Yes” and “Yes to All” will use the existing file(s) for the following steps



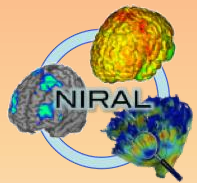
Atlas Settings

Going to Step 3

- If processing went right, “Next Step” button will replace the “Apply” button
- Clicking on “Next Step” will send you to Step 3

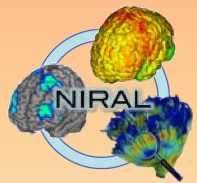


Step 3 : Analysis Settings



Analysis Settings

- In this step you will read statistical information from the previous extracted fiber
- An initialization will be done thanks to a plan file
- All those information will be gathered in one data sheet per cases
- Besides cases, those information will also be extracted from the Atlas Fiber to allow you to compare both files from case and atlas



Analysis Settings

Select planes

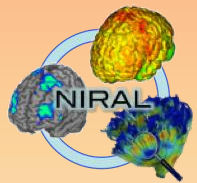
- Listed planes are FVP File read in the atlas directory
- Click to select or deselect a plane file
- A plane file should contains the name of the fiber to be read
- If no plane file is selected for a fiber, the tool will use an auto plane setting

Fiber's Plane file :

(Only selected planes will be used)
(If not, an auto plane will be used)

Genu.fvp

ILF-Right.fvp



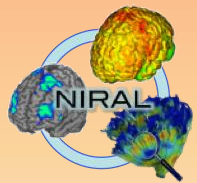
Analysis Settings

Select parameters

- Select which parameters you want to compute
- At least one parameter needs to be checked

Properties :

- | | | |
|---|--|-----------------------------|
| <input checked="" type="checkbox"/> FA | <input type="checkbox"/> lambda 1 = AD | |
| <input checked="" type="checkbox"/> MD | <input type="checkbox"/> lambda 2 | <input type="checkbox"/> RD |
| <input checked="" type="checkbox"/> Fro | <input type="checkbox"/> lambda 3 | <input type="checkbox"/> GA |



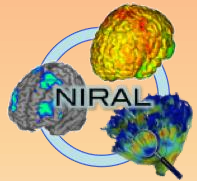
Analysis Settings

Select summary reports layout

- Gathered information (CSV Format) will be written as follow :
 - If you select “Arc length : row”, one data sample will correspond to one line and one case for one column
 - If you select “Case : row”, the table will be transposed

Summary reports

- Arc length : row / Case : column
- Case : row / Arc length : column



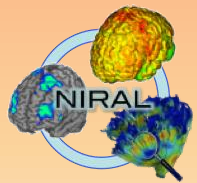
Analysis Settings

Select auto plane settings

- This option will define the origin point of an auto plane
- If “Center of Gravity” is checked, the origin will be the center of gravity of the whole fiber bundle
- If “Median point on Fiber” is checked, the origin will be the median point on the fiber
- The normal is always the direction between the two closest point to the origin

Auto Plane Origin Options

- Center of Gravity
- Median point on Fiber

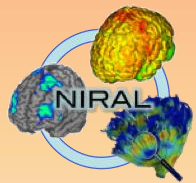


Analysis Settings

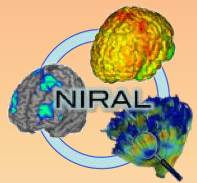
Calculating Statistics

- As in Step 2, click on the “Apply” button to calculate statistics and gathered information on a CSV File
- It will calculate statistics for each file created on Step 2
- One FVP File per call will be created and added in the Table plus one per fiber that will describe the atlas
- Gathered informations files are created as follow :
 - One file per fiber per parameter is created
 - Each file is named : *fibername_parameter.csv*
- When computation is finished, the “Next Step” button will replace the “Apply” button
- Click on “Next Step” to go to the Step 4

	1	Information file	Name	Genu.vtk	ILF-Right.vtk	Genu.fvp	ILF-Right.fvp
1	...ampdti.nhdr	...deformation	Test	...erAnalyzer-	...erAnalyzer-	...erAnalyzer-	...erAnalyzer-
2	...ampdti.nhdr	...deformation	Test1	...erAnalyzer-	...erAnalyzer-	...erAnalyzer-	...erAnalyzer-

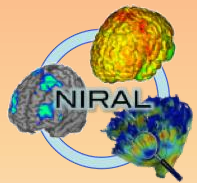


Step 4 : Plot Window



Plot Window

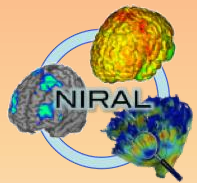
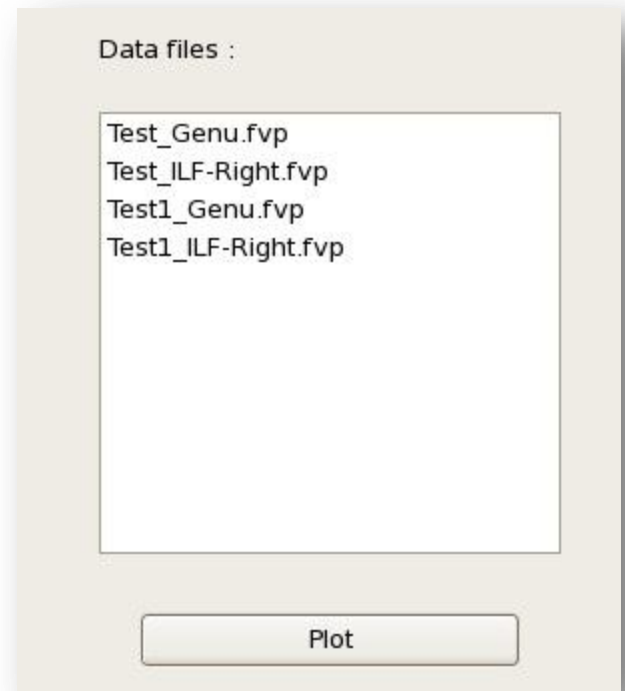
- This step helps you to compare statistical information by plotting them
- 3 types of curves can be distinguished : curves from cases, from atlas and statistical values such as mean and std
- You also will be able to check the correlation mapping between each cases and the atlas



Plot Window

Pop up the Plot Window

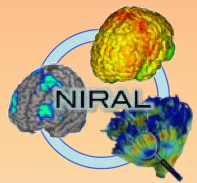
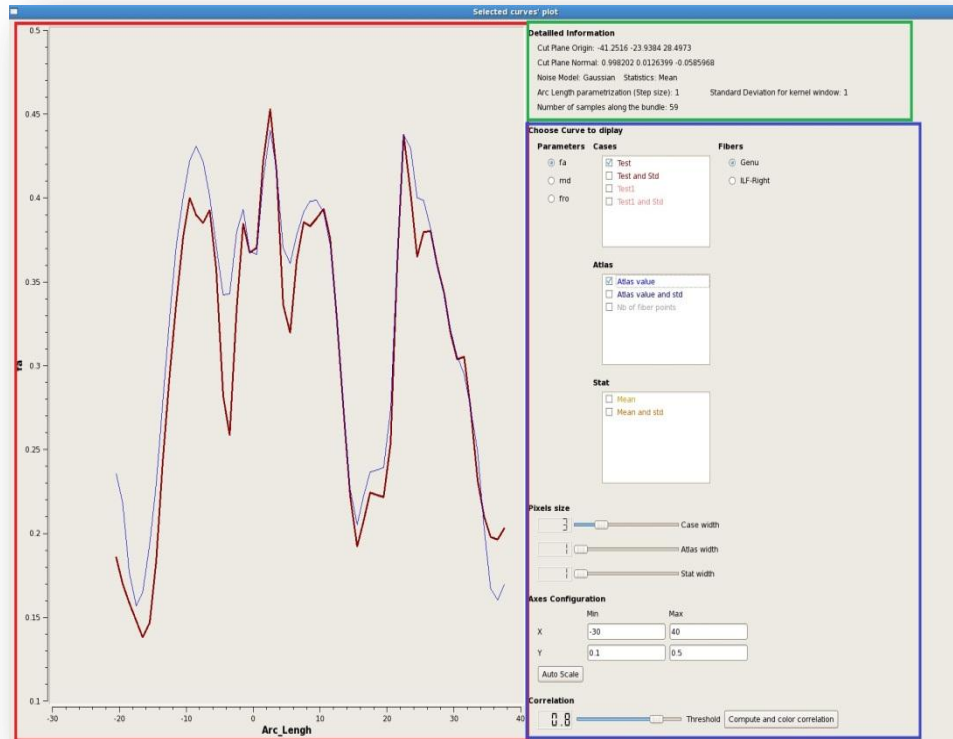
- The list shows which files will be plotted
- Only FVP Files can be read
- Click on “Plot” to open the plot window that will display each relevant curves



Plot Window

Window structure

- Plot Interface : Checked curves will be displayed here. Three kind of curves can be displayed :
 - Cases
 - Atlas
 - Statistic
- Detailed information of the FVP File read
- Option panel to change the display



Plot Window

Selecting displayed curves

- Choose which parameter to display for each curves
- Then, Check a box corresponding to a case to display the associated curve
- Choose the fiber you want to display
- Just one parameter and one fiber can be selected at a time
- Standard deviation curves are plotted with discontinue dashes

Choose Curve to display

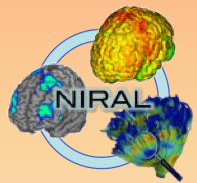
Parameters	Cases	Fibers
<input checked="" type="radio"/> fa	<input checked="" type="checkbox"/> Test	<input checked="" type="radio"/> Genu
<input type="radio"/> md	<input type="checkbox"/> Test and Std	<input type="radio"/> ILF-Right
<input type="radio"/> fro	<input type="checkbox"/> Test1	
	<input type="checkbox"/> Test1 and Std	

Atlas

<input checked="" type="checkbox"/> Atlas value
<input type="checkbox"/> Atlas value and std
<input type="checkbox"/> Nb of fiber points

Stat

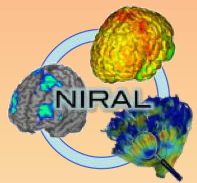
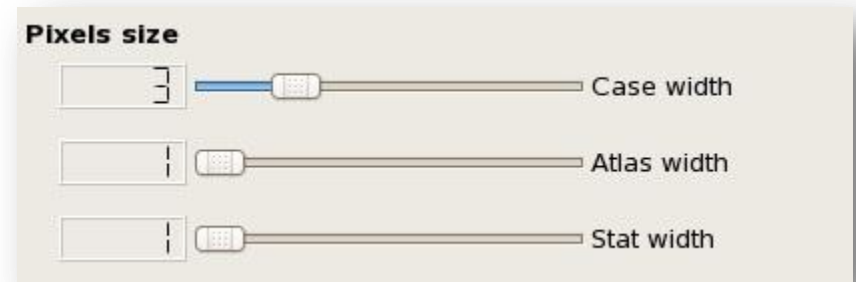
<input type="checkbox"/> Mean
<input type="checkbox"/> Mean and std



Plot Window

Adapting pixel size

- Use Sliders to change the pixel size for each type of curves
- Pixel width “1” is set as default



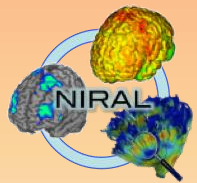
Plot Window

Configure axes scales

- This is where you can set the axis scales
- The Plot will be updated each time you finished entering a number
- Click on “Auto Scale” button to auto set the values depending on plotted curves

Axes Configuration

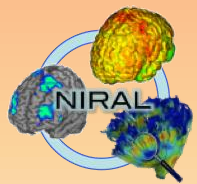
	Min	Max
X	<input type="text" value="-30"/>	<input type="text" value="40"/>
Y	<input type="text" value="0.1"/>	<input type="text" value="0.5"/>



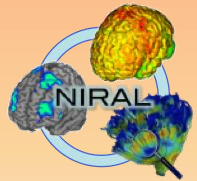
Plot Window

Get correlation coefficients

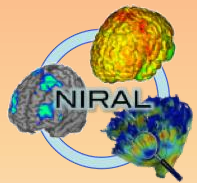
- Each Case curves have a correlation coefficient with the Atlas curve
- If the correlation between a curve and the atlas is below the correlation threshold this curve will be colored in red
- Colors on curves correspond to colors on case names
- Click on “Correlation check mapping” to display all of the correlation coefficients and color each curves depending on the coefficient : (Light grey for 1 and black for 0)



Additional Information

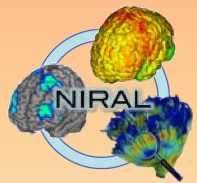


Merging Statistic With Fiber Data



Merge Stat With Fiber

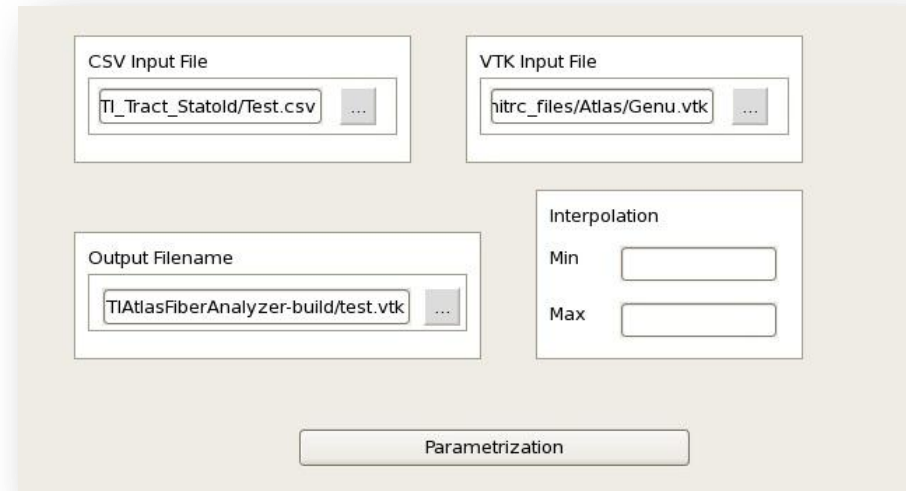
- This tool will use a data sheet to merge data in the original .vtk file of a fiber
- This will allow you to display each parameter value distribution in Slicer
- For instance, you will be able to see the 'Fa' distribution as a color map on the fiber



Merge Stat With Fiber

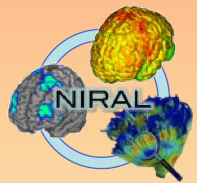
Specifying arguments

- Choose a CSV File containing data samples to merge
- Choose a VTK File for the data samples to be merged with
- Specify the name of the VTK Output File
- Choose Min and Max values of the linear interpolation that will computes Slicer data



The screenshot shows a software interface with the following fields and controls:

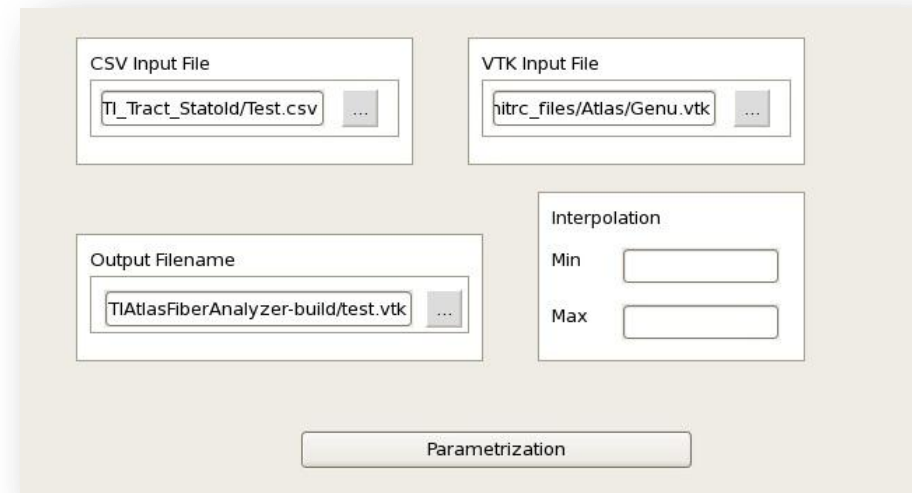
- CSV Input File:** A text box containing "TI_Tract_Statold/Test.csv" and a browse button "...".
- VTK Input File:** A text box containing "nitrc_files/Atlas/Genu.vtk" and a browse button "...".
- Output Filename:** A text box containing "TIAtlasFiberAnalyzer-build/test.vtk" and a browse button "...".
- Interpolation:** Two input fields labeled "Min" and "Max".
- Parametrization:** A button at the bottom of the interface.



Merge Stat With Fiber

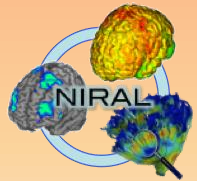
Calling MergeStatWithFiber

- Required fields:
 - CSV Input File
 - VTK Input File
 - Output Filename
- Optional field : Interpolation values
- Click on Parametrization and the result will be written on the Output Filename

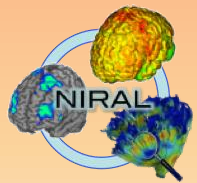


The screenshot shows a software interface with the following components:

- CSV Input File:** A text box containing "TI_Tract_Statold/Test.csv" and a browse button "...".
- VTK Input File:** A text box containing "nitrc_files/Atlas/Genu.vtk" and a browse button "...".
- Output Filename:** A text box containing "TIAtlasFiberAnalyzer-build/test.vtk" and a browse button "...".
- Interpolation:** A section with two input fields labeled "Min" and "Max".
- Parametrization:** A large button at the bottom.



Output Hierarchy



Output Hierarchy

Output Folder/

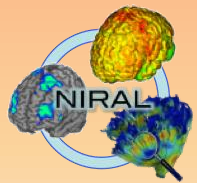
- Cases/

/CaseNames → Here will be stored Cases VTK Files and Statistics FVP Files for associated Case named : *casename_fibername.vtk* or *.fvp*

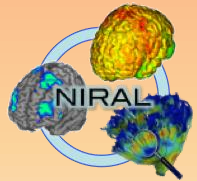
- Fibers/ → Here will be stored Statistics from Atlas VTK File for associated Fiber named : *fibername.fvp*

- FiberProfiles/

FiberNames → Here will be stored gathered information for associated parameter named : *parametername_fibername.csv*

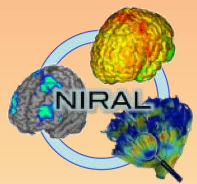


Automated Required Information Filling



Automated Required Information Filling

- There is two types of information files :
 - Data File :This one will fill information required for the first step such as the CSV File name
 - Analysis File :This one will fill information required for Step 2 and Step 3 such as desired parameters
- The global structure is :
 - A beginning line
 - List of Key :Value
- You can add commentaries by beginning a line by “#”
- Listed values should be separated with a coma
- A default Analysis File will be created at the tool first use. Feel free to modify it since it will be loaded automatically for next uses. This default file located in the Output Folder is called :
Default_Analysis_Parameters.txt
- Use the file menu to Save or Load those different files



Automated Required Information Filling

Writing a Data File

- The first line must be :*“Data parameters for DTIAtlasFiberAnalyzer :”*
- Then, you can specify each of the following (Order doesn't matter) :
 - *“CSVFile :”* + Path to the CSV File name
 - *“Data Column :”, “Deformation Field Column :”* or *“Case Column :”* + number of the designated column
 - *“Field Type :”* + *“h-field”* or *“displacement field”* describing the deformation fields you will be using
 - *“Output Folder :”* + Path to the chosen output folder name
- Example :

Data parameters for DTIAtlasFiberAnalyzer :

CSVFile : /path/to/CSV/File.csv

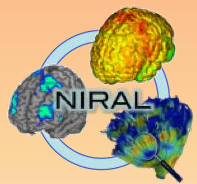
Data Column : 1

Deformation Field Column : 2

Field Type : displacement field

Case Column : 3

Output Folder : /path/to/Output/Folder



Automated Required Information Filling

Writing an Analysis File

- The first line must be :*“Analysis parameters for DTIAtlasFiberAnalyzer :”*
- Then, you can specify each of the following (Order doesn't matter) :
 - *“Atlas Fiber Folder :”* + Path to the Atlas Folder
 - *“Selected Fibers :”* + Name of each Fiber Files (in the Atlas Folder)
 - *“Selected Planes :”* + Name of each Plane Files (in the Atlas Folder)
 - *“Profile parameter :”* + Name of each Parameters
 - *“Col and Row :”* + Either *“Case in row”* or *“Case in col”* to transpose or not the gathered information table
 - *“Auto Plane Origin :”* + Either *“median”* or *“gravity”*
- Example :

Analysis parameters for DTIAtlasFiberAnalyzer :

Atlas Fiber Folder : /path/to/Atlas/Folder

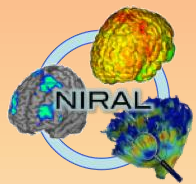
Selected Fibers : Genu.vtk, ILF-Right.vtk

Selected Planes : Genu.fvp

Profile parameter : fa,md,fro

Col and Row : Case in row

Auto Plane Origin : median



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