DTI Atlas Registration via 3D Slicer and DTI-Reg

Martin Styner, UNC

Clement Vachet, UNC

Jean-Baptiste Berger, UNC

DTI Registration

- This tutorial teaches you how
    - What fiber tract analysis is
    - How to perform a fiber tract measurements via DTIAtlasFiberAnalyzer in Slicer

- DTIAtlasFiberAnalyzer
    - On NITRC, works also as standalone
    - Works on population/groups of datasets

Dataset

For this tutorial you will need DTI and fiber data files that can be found on this link :
http://hdl.handle.net/1926/1759

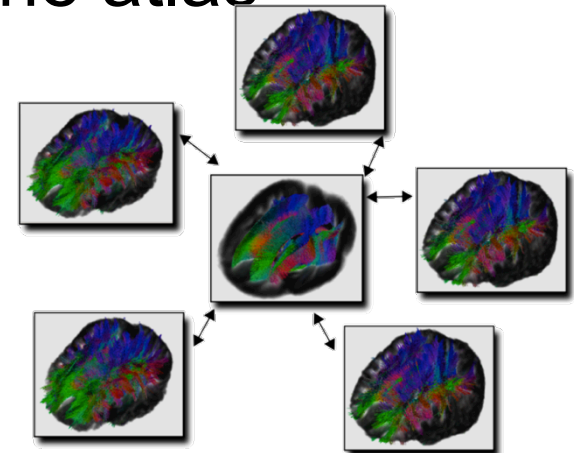# Needed Ingredients

1. A DTI atlas with fiber tracts
   – Create your own atlas
     - Track in Slicer, process with FiberViewerLight
       – Separate Tutorial
     - Atlas building in Slicer in progress

2. DTI datasets mapped into the atlas
   a. Directly mapped DTI data
   b. DTI & Deformation field data
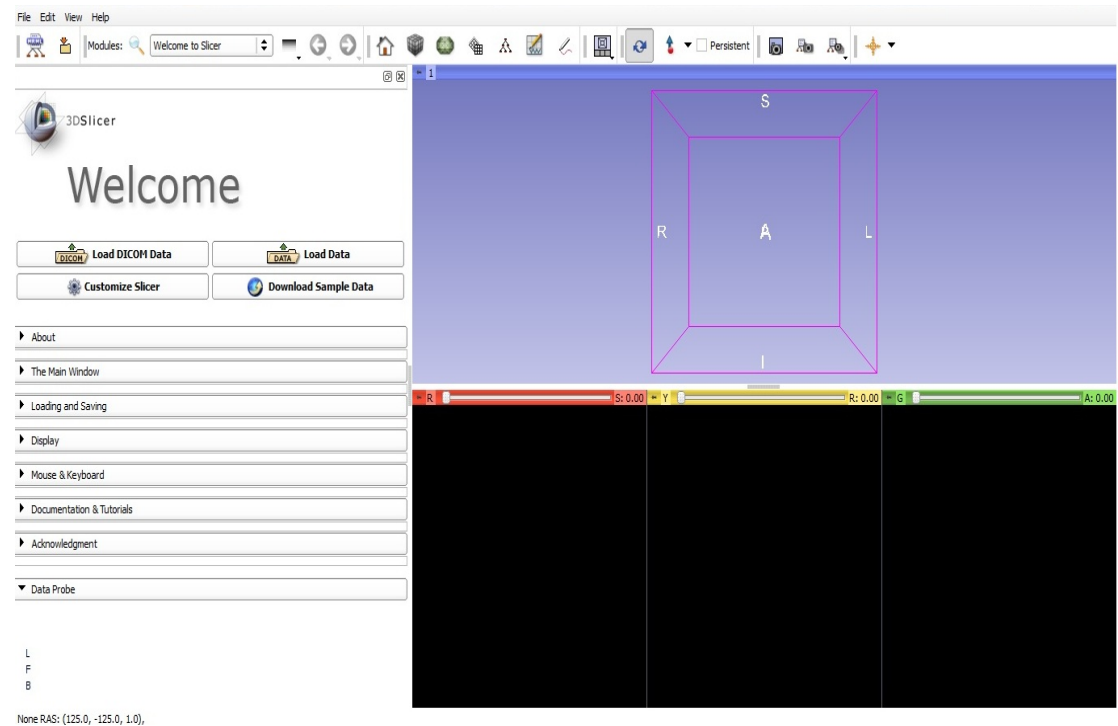
Let's get started: Slicer 4

Linux/Mac users :
Launch the Slicer executable located in the Slicer4 directory

Windows users :
Select Start→All Programs→Slicer4.0.1→Slicer

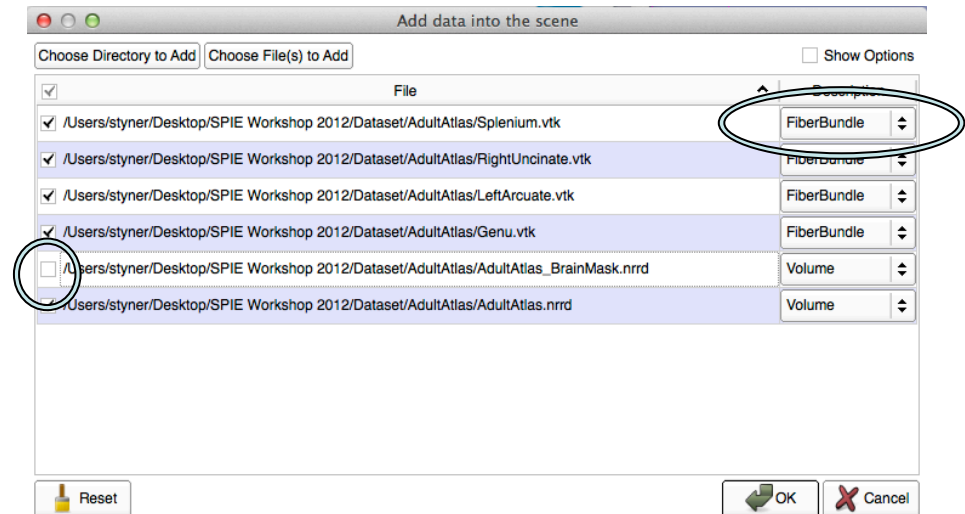Or launch the Slicer executable from Slicer4 directory

Load Atlas & Fibers

- Add Data in File Menu
  - Select all files in DTI atlas folder
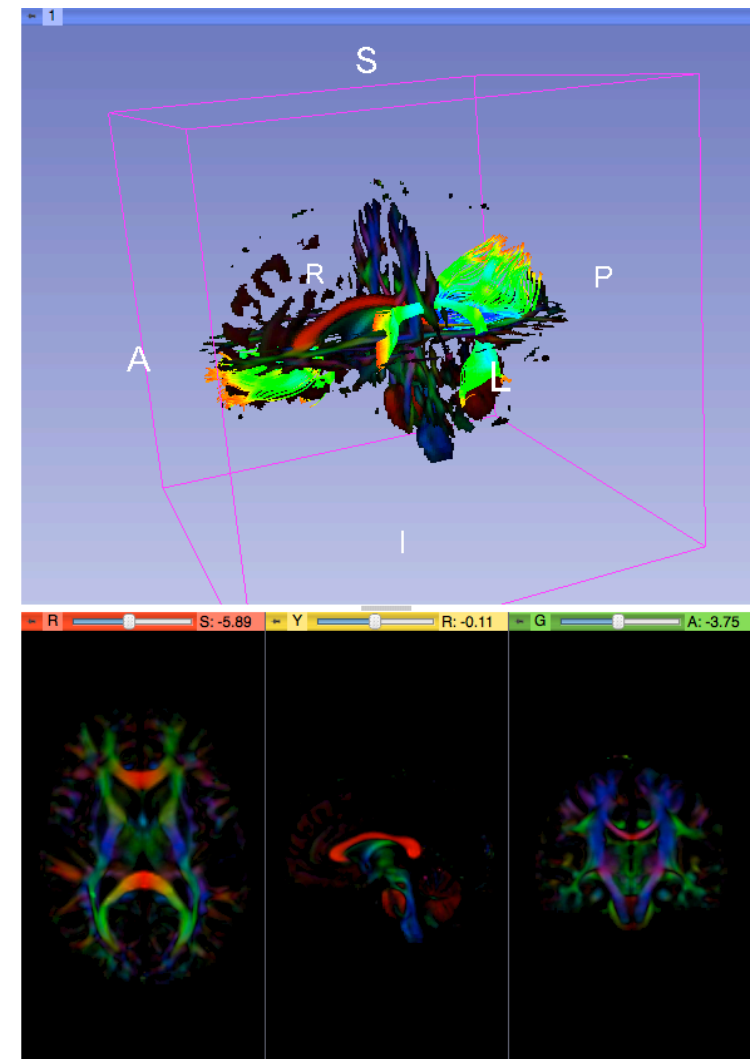 - Change description to FiberBundle for fibers
  - No mask
  - Okay!

DTI Atlas & Fibers

- Link slices

- Enable threshold in Volume module

- Example tracts:
  - CC Genu
  - CC Splenium
  - Uncinate right hemi
  - Arcuate left hemi

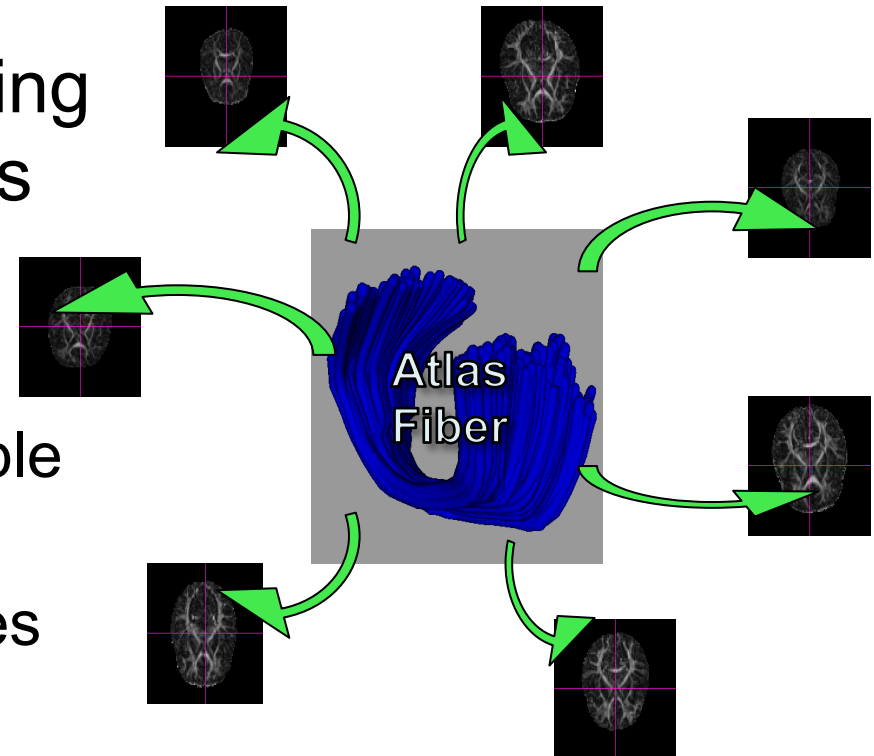- Not anatomically verified!!

Fiber based Analysis

- Analyze corresponding fiber locations across datasets via atlas
  - Mapping into atlas
  - Inverse map to sample fibers
  - Compute fiber profiles
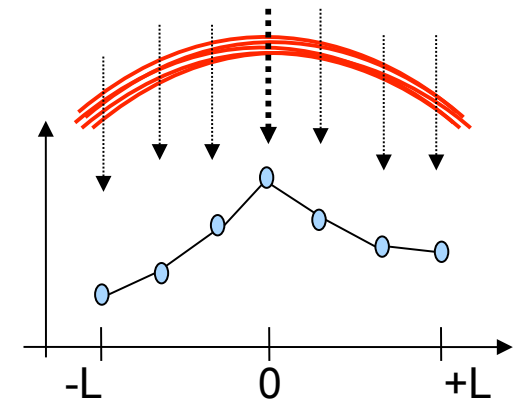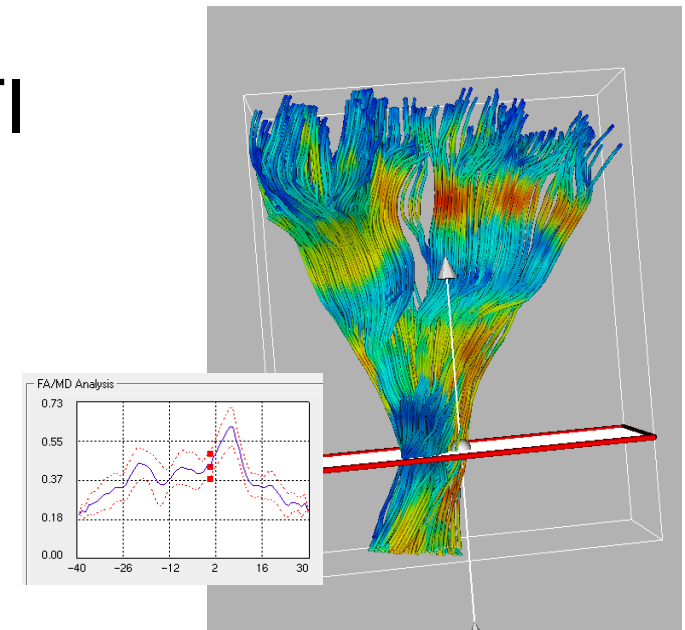   - FA, MD, AD, RD…
  - Analyze the profiles

Atlas Fiber

DTI Property Fiber Profiles

- Profile = Distribution of DTI values *across* fiber bundle
  - Average & deviation

- Parameterization of each fiber *along* fiber bundle
  - Uniform stepsize
  - Origin definition
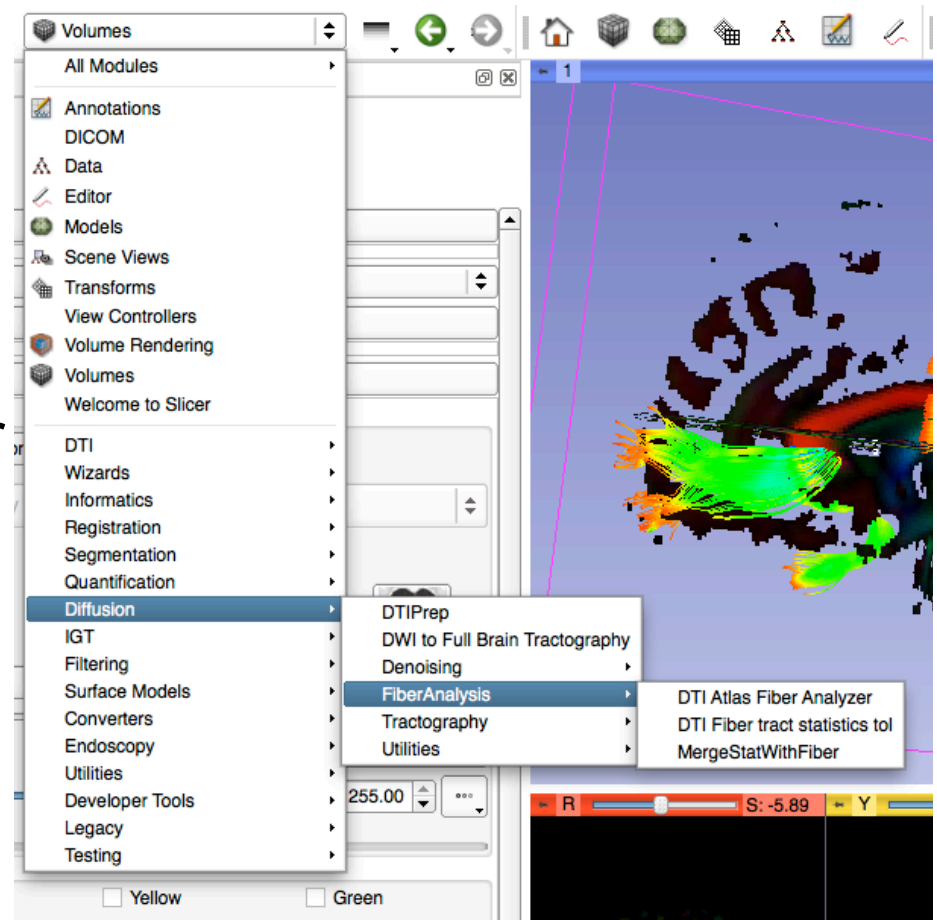   - Manual
    - Automatic (2 ways)

DTI Atlas Fiber Analyzer

- Separate tool called from Slicer
  - Diffusion
  - FiberAnalysis
  - DTI Atlas Fiber Analyzer
- Create new command line module
- Apply!

DTI Atlas Fiber Analyzer

- Made for analyzing many datasets at once
- .csv = comma separated value
- Data can be prepared with Excel or other editors

Data definition | Attribute fibers | Fibers properties | Plotting parameters | MergeStatWithFiber

Load CSV : filename :

New CSV :

Number of da   1
Number of col   1

Apply

Column :

new header
Add Column
Delete column

Row :

Add Row
Delete row

Save CSV

Delete CSV

Column with the Individual data Images :
(green color)
Column with the Deformation Field (optional) :
(blue color)
Column with the name of cases (optional) :
(orange color)

Output Folder :

Load prior csv file

Tabs for the 4 main steps

evious Ste   Next Step   Computes A

Computation file :

1

1

DataTable Area

Step 1: Data Definition I

Create your datatable from scratch
- 1 row for 1 dataset
- 3 columns
  - SubjectID
  - Path to volume
  - Path to Deformation
- "Apply" to create the datatable

Step 1: Data Definition II

1. Double click headers to edit
2. Set Subject Column to 1
3. Set dataset column to 2
4. Set deformation column to 3
5. Double click on "no data" to browse for datafile
6. Double click on "no deformation" to browse for deformation file

Save the CSV Data

1. Save CSF File
2. Set Output folder for processing data
3. Next Step

Step 2: Atlas Definition

1. Set Atlas to tutorial atlas
   - Available fibers are automatically detected
2. Select fibers to be analyzed
   - Add Genu or Add All
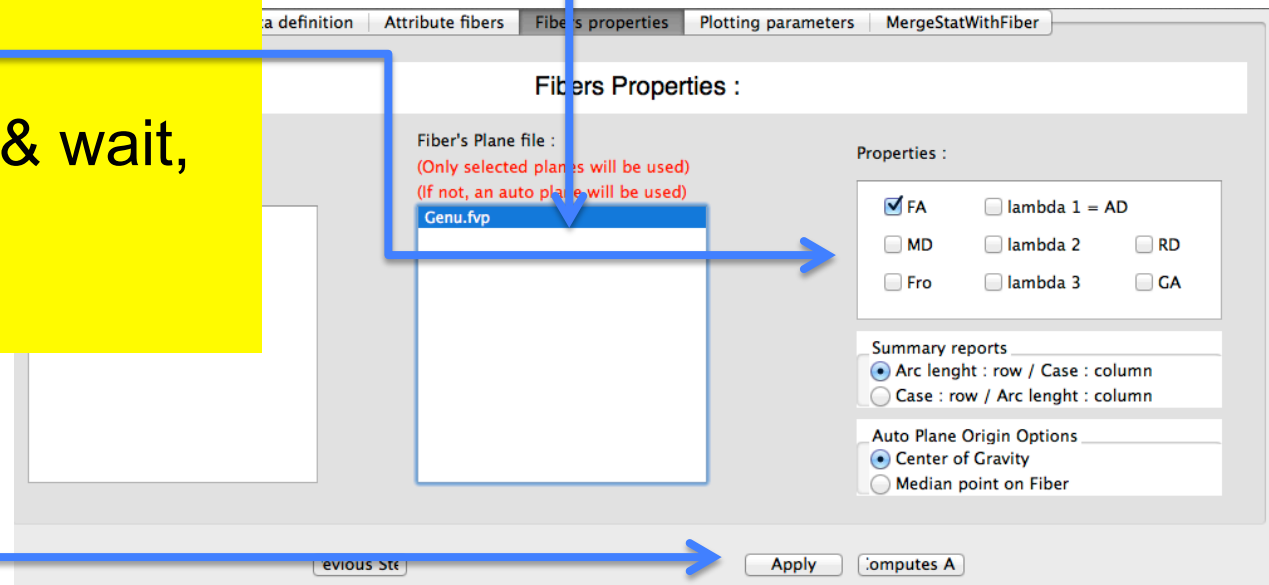3. "Apply" to run, if data exists, asks about rerun
4. "Next"

Atlas Fiber Folder :

E Workshop 2012/Dataset/AdultAtlas   ...

Fibers in the Atlas :

Genu.vtk
LeftArcuate.vtk
RightUncinate.vtk
Splenium.vtk

>>

<<

Add All

Remove Al

selected fibers :
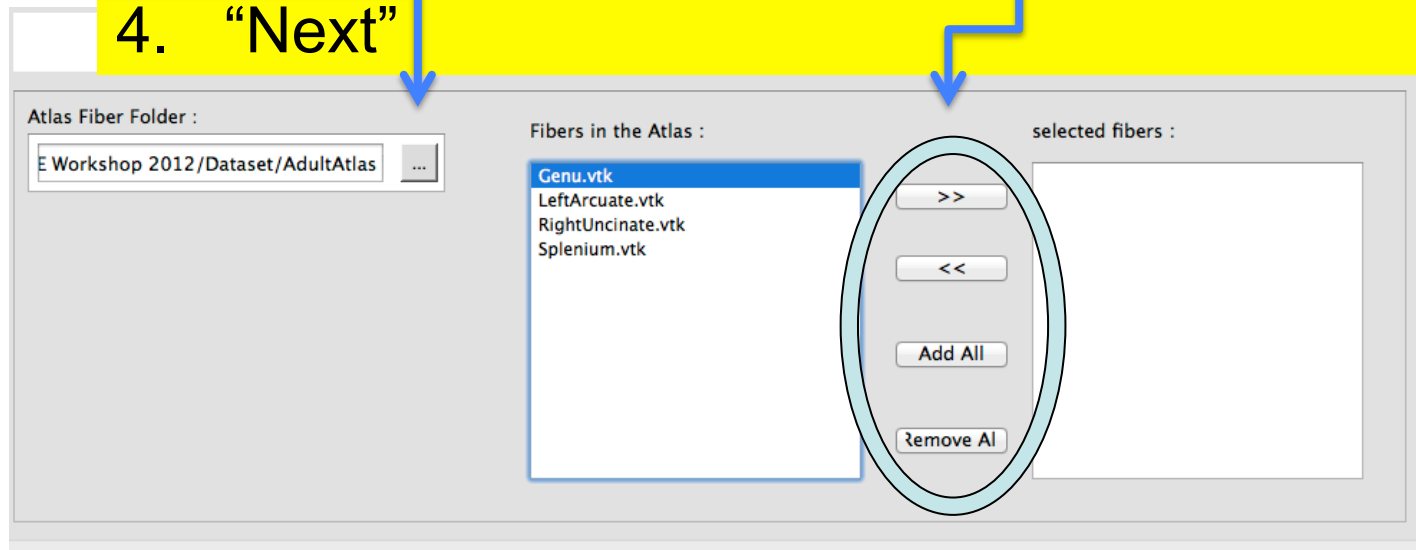
Step 3: Fiber Profiles

- **Manual vs Auto origin**
  - Autodetect if in atlas
    - None here

- **Properties**
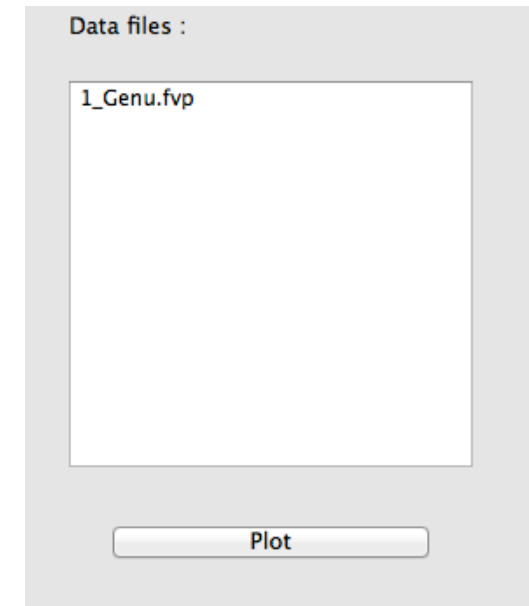 - Select FA

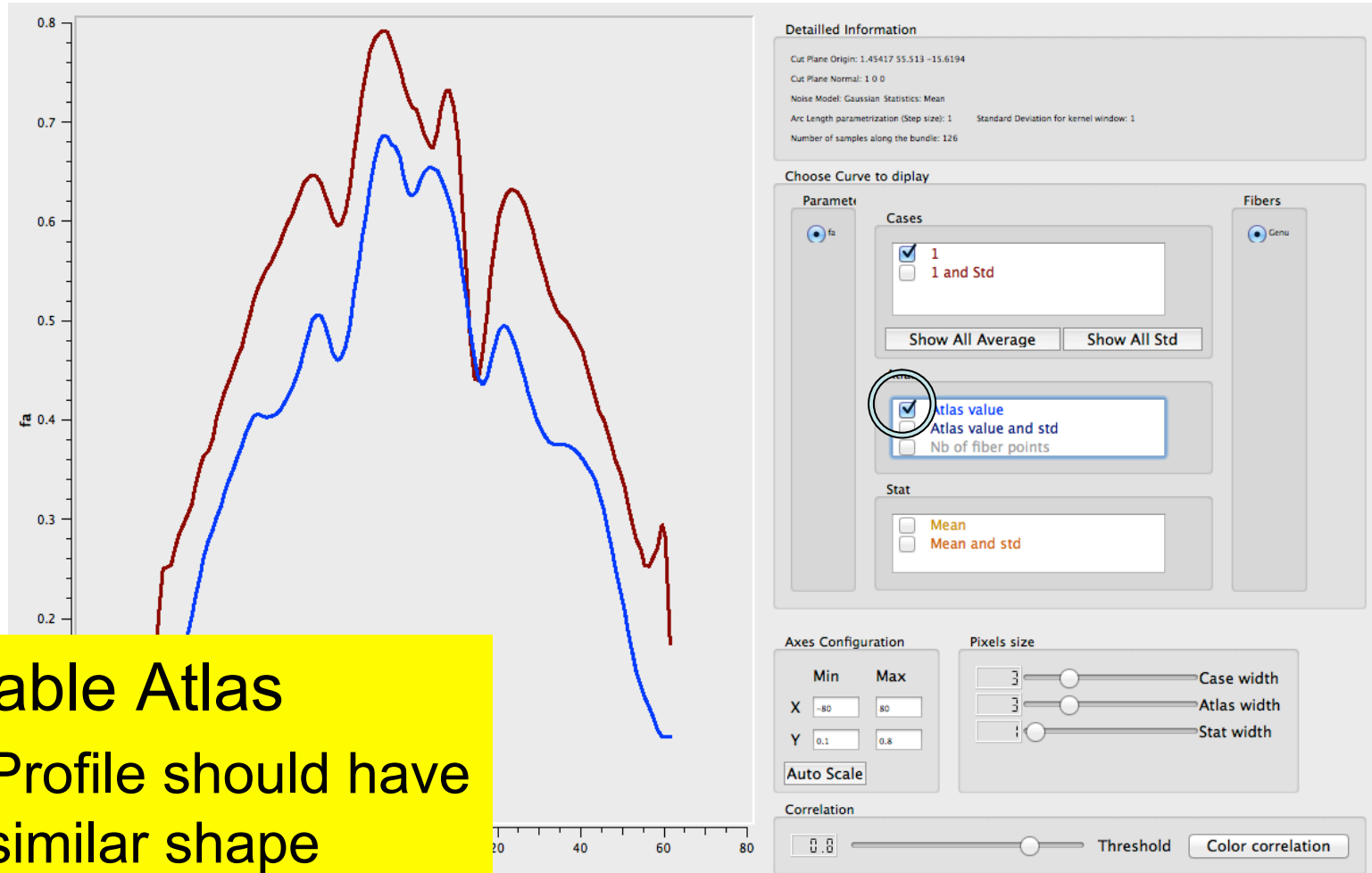- **"Apply" to run & wait, then "Next"**

Step 4: QC with Plots

- Select Genu stat
- And "Plot"

Fiber Parametrization

Plot-Window

Data files :

1_Genu.fvp

Step 4: QC with Plots II

- Enable Atlas
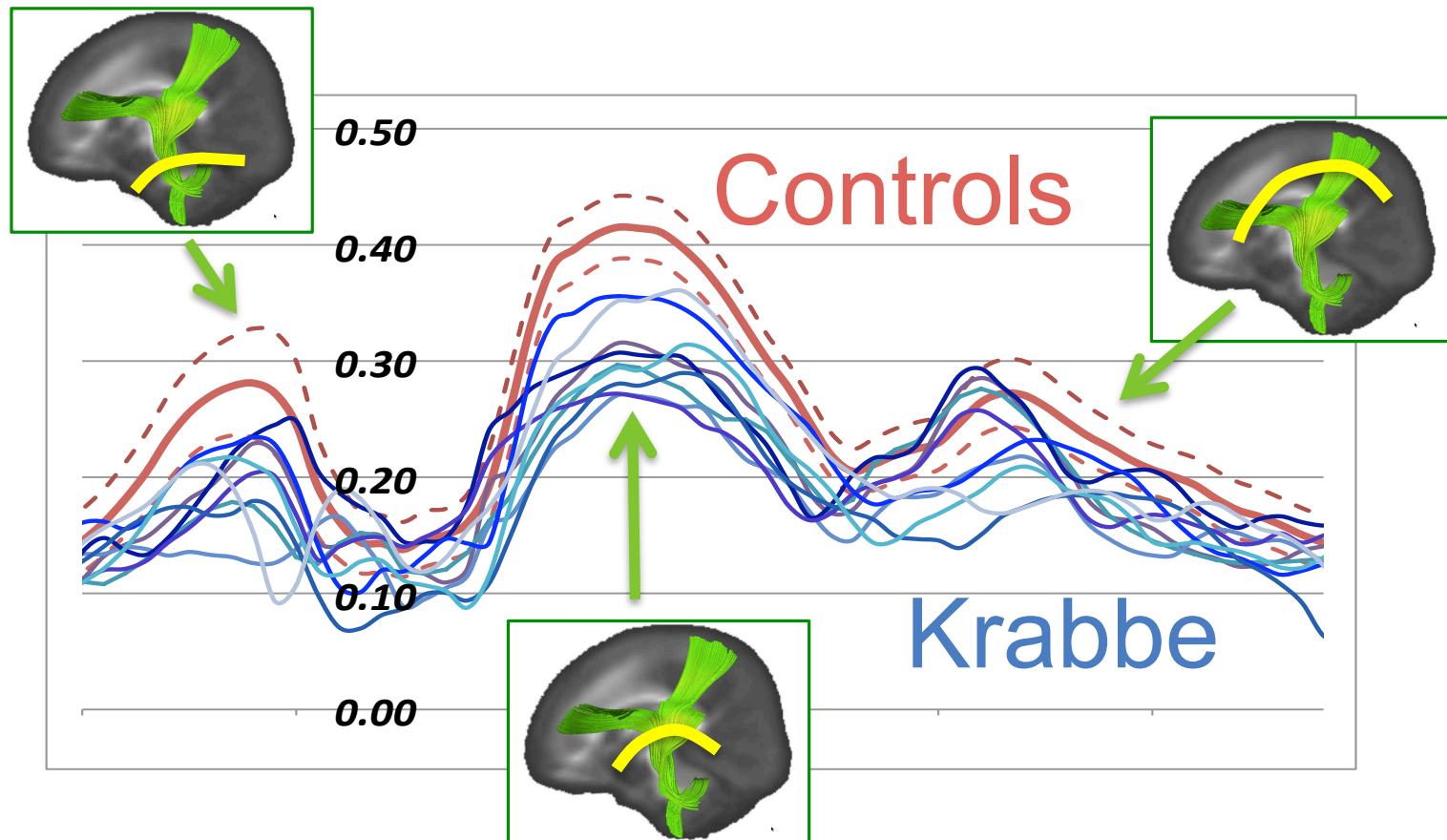 - Profile should have similar shape

Stats in Summary CSV

- Fiber profiles are all gathered in single CSV

- Use Excel for plotting

- Use your favorite stats tool for analysis
  - FADDTS: Zhu et al

- You can merge results back with parametrized fiber
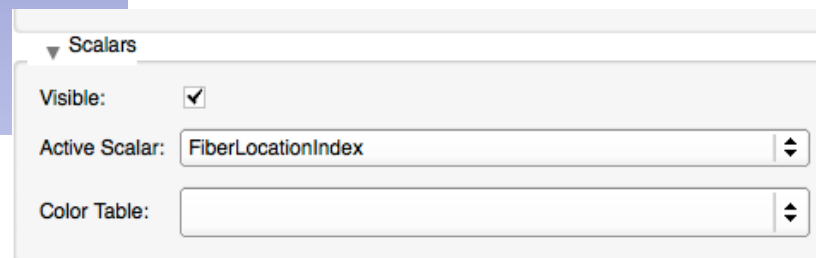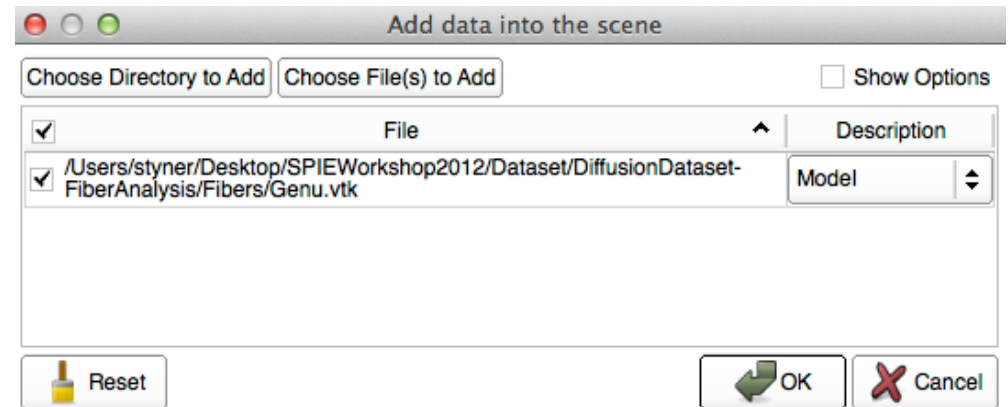 - Last Step: MergeStatWithFiber
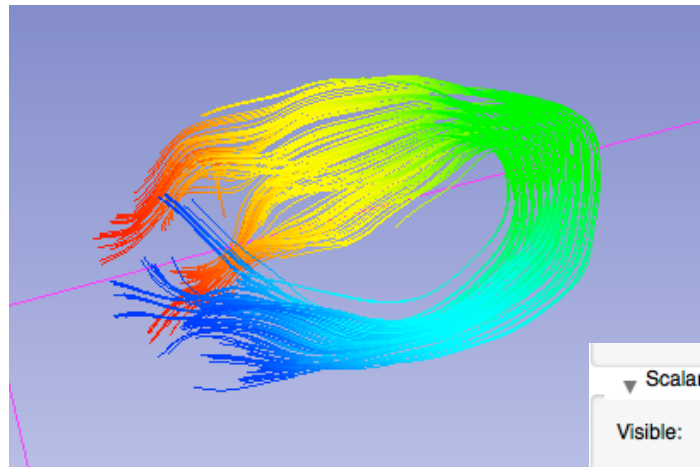
Example: Profiles in Excel

Taste of Visualization

- Load parameterized genu fiber
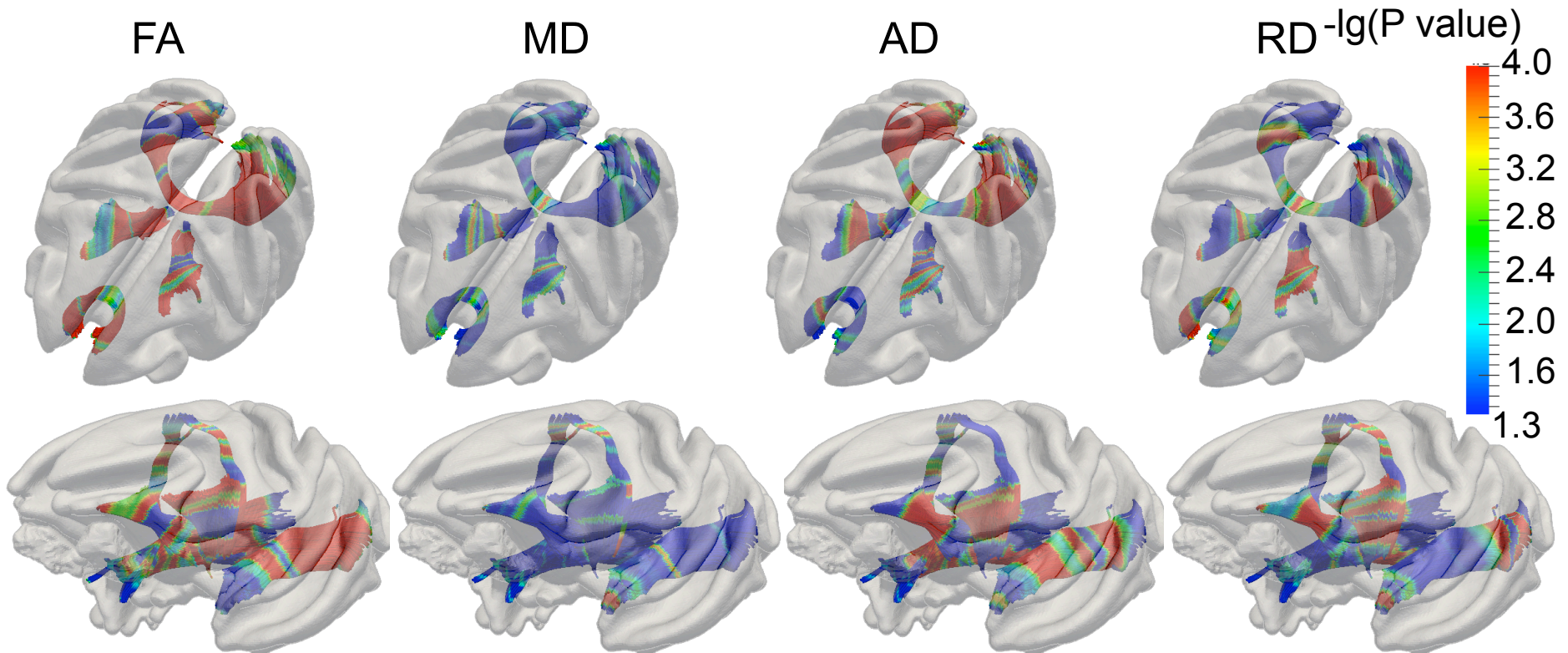 - Add Data => Model

- Enable scalars and use FiberLocationIndex

Example: Visualization of fiber tract statistics

- Visualization in Slicer or ParaView
- Add a model of brain surface for effect

FA MD AD RD

-lg(P value)

Conclusions

- Fiber profile analysis with Slicer
  - DTI Atlas Fiber Analyzer
  - Registration to atlas needed

- Future: An easy-to-use stats tool

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