

Rodent Cortical Thickness Analysis

Measure cortical thickness of rodent brain



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Principle

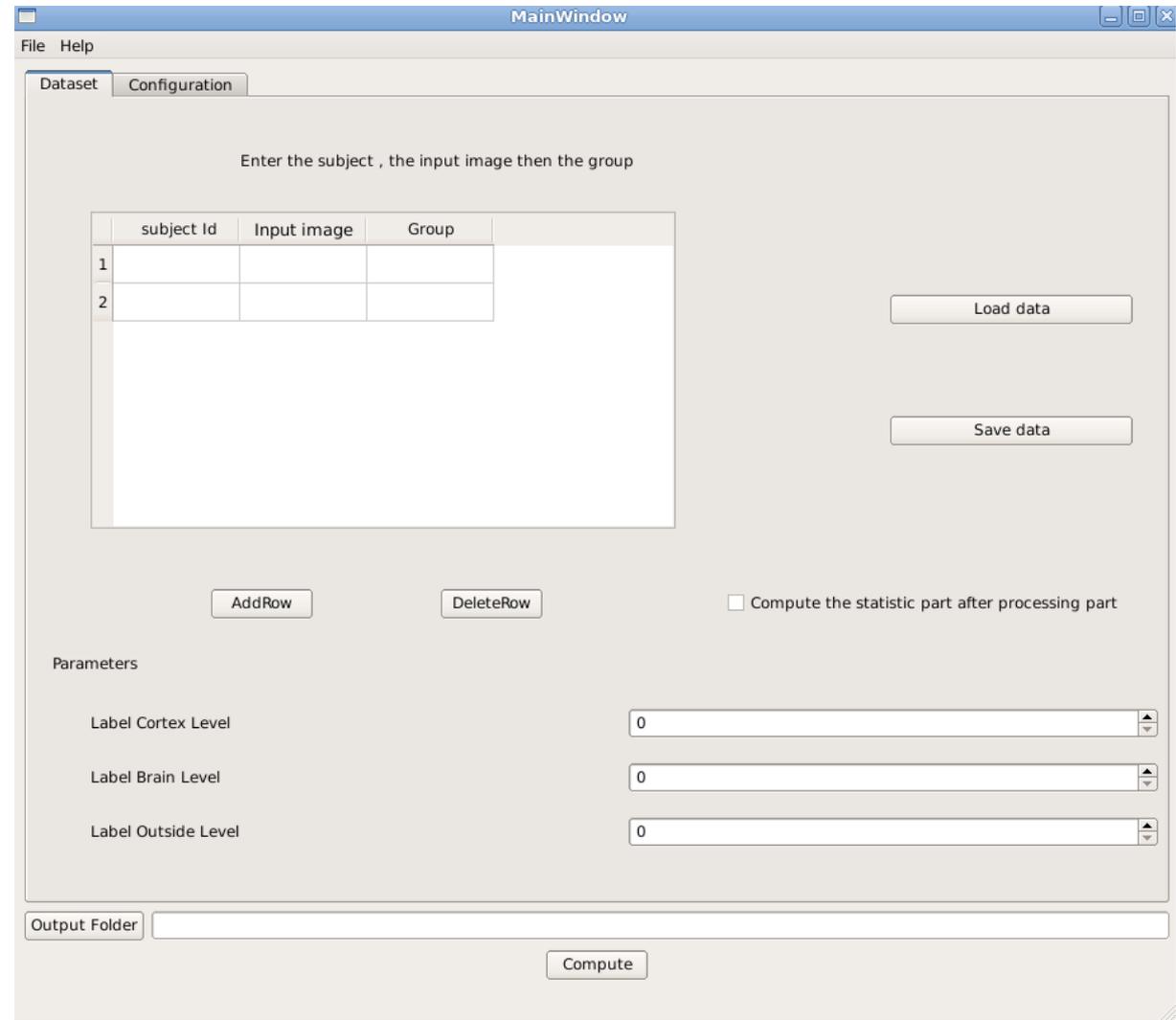
- “RodentThickness” is an automatic cortical thickness measurement tool for rat brains.
The different parts of the pipeline are :
- Preprocessing to create binary mask and label map
- Run `measureThicknessFilter` which produces laplacian field and thickness map in order.
- Run particle correspondence.
- Thickness sampling using particle correspondence result.
- Statistical analysis resulting in mean thickness color map and t-test result.

Different uses

- You can use Rodent Cortical Thickness Analysis :
 - With GUI
 - in Slicer (check the box noGUI)
 - in Command Line (--nogui)

GUI

- Run the interface :
./RodentThickness



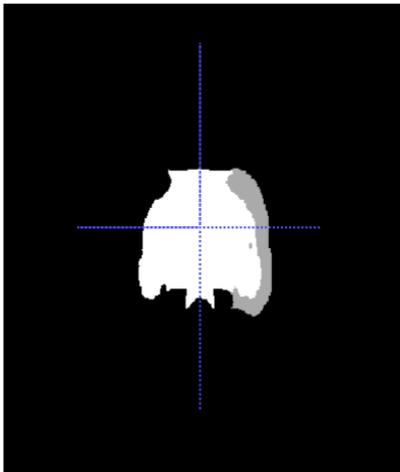
Input and Output

- The input file is the dataset CSV containing :
SubjId and Input Image are required and a third input Group is needed if you compute statistical part.
- The input image is a label map of the rodent brain.
- SubjId is the name of the subject.
- The group is the name for each subjects. You must have exactly two groups if you want to compute the statistics. If you don't want to, you don't need to fill this column
- All the outputs are summarized in a csv file named outputdataset.csv

Parameters

- The label values of the binary segmentation image and the input parameters must match.
 - Cortex level (default 1).
 - Idl : Id number for the low Dirichlet boundary condition : it's the rest of the brain (default 4).
 - Idh : Id number for the high Dirichlet boundary condition: it's the background (default 0).

Label Map



- Grey : Cortex
- White : Brain
- Black : Outside

Load CSV File if available

- You can load a CSV file containing paths to a Dataset you saved before or you wrote yourself with this style:

```
subjid,labelMapInput,group  
1,image1.nrrd,A  
2,image2.nrrd,A  
3,image3.nrrd,B  
4,image4.nrrd,B
```

MainWindow

File Help

Dataset Configuration

Enter the subject , the input image then the group

	subject Id	Input image	Group
1			
2			

Load data

Open CSV file as Dataset

Save data

AddRow DeleteRow

Compute the statistic part after processing part

Parameters

Label Cortex Level 0

Label Brain Level 0

Label Outside Level 0

Output Folder

Compute



Else configuring images to process

- Clicking on the table will allow you to select images, or enter the subject and the group.
- You have to fill the column group only if you check the box “Compute Statistics”

MainWindow

File Help

Dataset Configuration

Enter the subject , the input image then the group

subject Id	Input image	Group
1		
2		

Load data

Save data

AddRow DeleteRow

Compute the statistic part after processing part

Parameters

Label Cortex Level 0

Label Brain Level 0

Label Outside Level 0

Output Folder

Compute



Save CSV File

- You can save your Dataset into a CSV file so you can load it and use it again later.

MainWindow

File Help

Dataset Configuration

Enter the subject , the input image then the group

	subject Id	Input image	Group
1			
2			

Load data

Save data

Generate a CSV file with Dataset

Compute the statistic part after processing part

Parameters

Label Cortex Level 0

Label Brain Level 0

Label Outside Level 0

Output Folder

Compute



Add and delete row

- If you select a row , you can add and delete a row at this place , if no row are selected it is on the last of the table.

MainWindow

File Help

Dataset Configuration

Enter the subject , the input image then the group

	subject Id	Input image	Group
1			
2			

Load data

Save data

AddRow DeleteRow

Compute the statistic part after processing part

Parameters

Label Cortex Level 0

Label Brain Level 0

Label Outside Level 0

Output Folder

Compute



Give an output folder

- You need to give an output folder: folders will be created in your output folder, and all the files generated by the program will be put in it.

MainWindow

File Help

Dataset Configuration

Enter the subject , the input image then the group

	subject Id	Input image	Group
1			
2			

Load data

Save data

AddRow DeleteRow

Compute the statistic part after processing part

Parameters

Label Cortex Level 0

Label Brain Level 0

Label Outside Level 0

Output Folder

Compute



Statistical Analysis

- If you check the box Statistical , you have to fill the column Group.
- Statistic part needs two different groups.
- If you don't compute the statistics , you don't have to fill the column Group.

The screenshot shows a software application window titled "MainWindow" with a menu bar containing "File" and "Help". The window has two tabs: "Dataset" (selected) and "Configuration". Below the tabs, there is a text prompt: "Enter the subject , the input image then the group". A table with three columns is displayed: "subject Id", "Input image", and "Group". The table has two rows, numbered 1 and 2. To the right of the table are two buttons: "Load data" and "Save data". Below the table are two buttons: "AddRow" and "DeleteRow". A checkbox labeled "Compute the statistic part after processing part" is circled in red. Below this is a "Parameters" section with three input fields: "Label Cortex Level" (value 0), "Label Brain Level" (value 0), and "Label Outside Level" (value 0). At the bottom, there is an "Output Folder" input field and a "Compute" button.

	subject Id	Input image	Group
1			
2			



Software configuration

- If you have your own version of the programs or if you need to use a particular version of it, you can write the path manually or click the button to search it.
- If you don't compute the statistical part, you don't have to fill the path for Rscript (2), concatToColumns and vtkPointAttributes.

MainWindow

File Help

Dataset Configuration

Rodent Thickness Configuration file

measureThicknessFilter		R
GenParaMeshCLP		R
ParaToSPHARMMeshCLP		R
MeshPointsIntensitySampling		R
ShapeWorksRun		R
ShapeWorksGroom		R
ImageMath		R
SegPostprocessCLP		R
Python Path		R
RScript Path		R
BinaryToDistanceMap		R
ShapeWorksPythonScript		R
concatToColumnsPythonScript		R
vtkPointAttributesPythonScript		R
RScript " rodentThickness.r "		R

Default

Directory containing Batchmake Script

Output Folder

Compute



Automatic Configuration

- By clicking the "Default" button, the program will automatically search all the programs in the PATH, and tell you if some of them are missing.

The screenshot shows a software window titled "MainWindow" with a "File" menu. The "Configuration" tab is active, displaying a "Rodent Thickness Configuration file" section. This section contains a list of program names and their paths, with a "Default" button circled in red. Below the list is a text box for the "Directory containing Batchmake Script" and an "Output Folder" field. A "Compute" button is at the bottom.

Program Name	Path	Action
measureThicknessFilter		R
GenParaMeshCLP		R
ParaToSPHARMMeshCLP		R
MeshPointsIntensitySampling		R
ShapeWorksRun		R
ShapeWorksGroom		R
ImageMath		R
SegPostprocess		R
Python Path		R
RScript Path		R
BinaryToDistanceMap		R
ShapeWorksPythonScript		R
concatToColumnsPythonScript		R
vtkPointAttributesPythonScript		R
RScript " rodentThickness.r "		R

Default
Use the program paths given by the system

Directory containing Batchmake Script

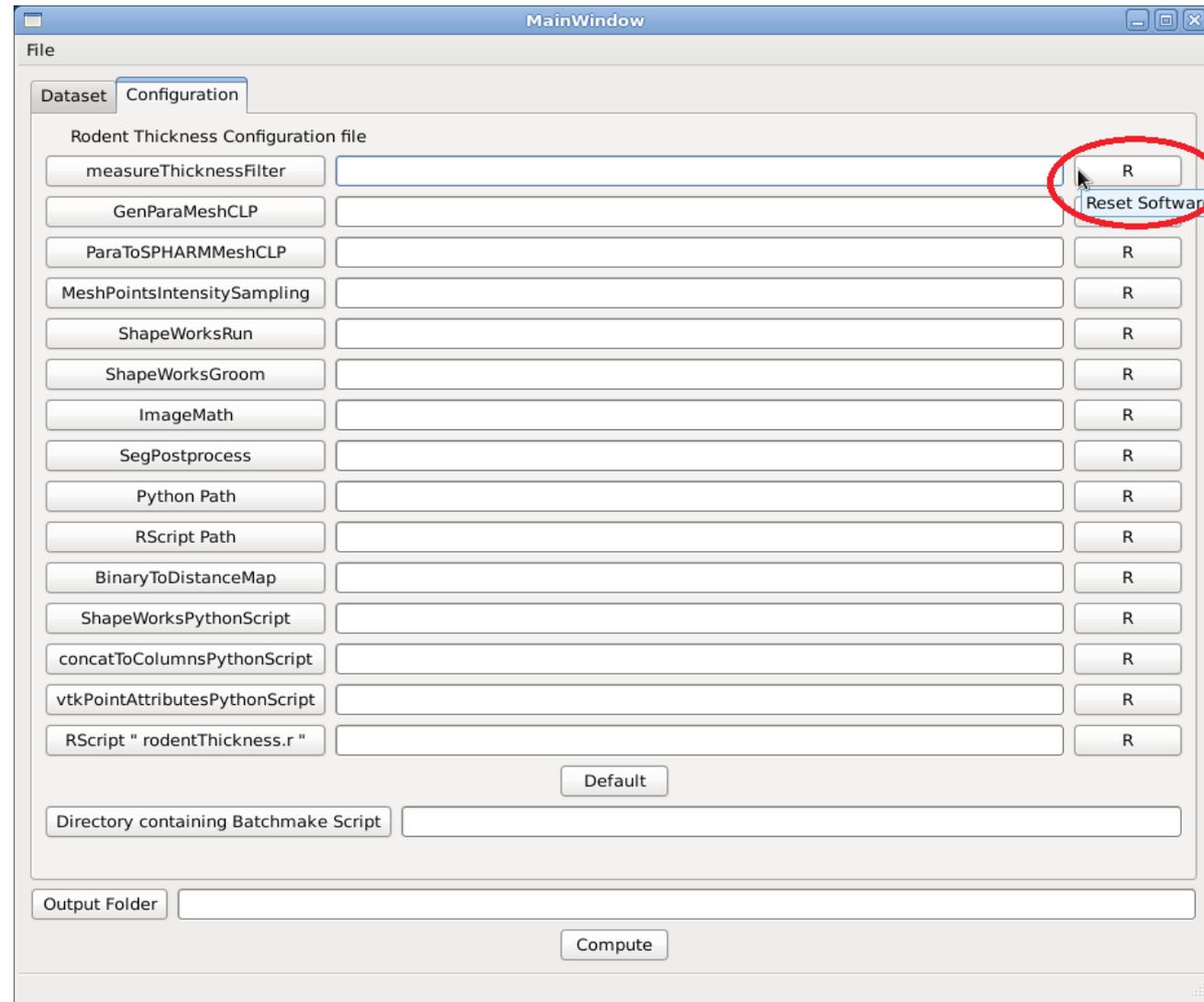
Output Folder

Compute



Automatic Configuration

- If you want to reset the path for one or more programs, just push the "R" button and it will search the corresponding program in the PATH.



Load and Save

- Save your configuration: In the « File » Menu, you can Save or Load a configuration file generated by the program.
- When opening the program, it will automatically search and load any file called “RodentThicknessconfigfile.bms” in the directory where the executable is and in the current work directory.



Software Configuration

- Python version : Python 2.6 or Python 2.7 with vtk installed.
- If you want to compute Statistics , you need to put niralvtk.py in the same folder as vtkPointAttributes.py.



Compute

- When you fill the table, the configuration and gave an output folder, you can compute Rodent Thickness by clicking the "Compute" button. It will test the existence and type of the files and the folders and tell you if some files are not images .

The screenshot shows a software window titled 'MainWindow' with a menu bar containing 'File' and 'Help'. Below the menu bar are two tabs: 'Dataset' and 'Configuration'. The main area contains the instruction 'Enter the subject , the input image then the group' above a table with three columns: 'subject Id', 'Input image', and 'Group'. The table has two rows, numbered 1 and 2. To the right of the table are two buttons: 'Load data' and 'Save data'. Below the table are two buttons: 'AddRow' and 'DeleteRow'. To the right of these buttons is a checkbox labeled 'Compute the statistic part after processing part'. Below this is a 'Parameters' section with three rows: 'Label Cortex Level', 'Label Brain Level', and 'Label Outside Level', each with a numeric input field set to '0'. At the bottom left is an 'Output Folder' label and an empty text box. At the bottom center is a 'Compute' button, which is circled in red.

	subject Id	Input image	Group
1			
2			



Command line

« RodentThickness --help » :

•Load :

--dataset <std::string> : CSV file containing the dataset

--configfile <std::string> : Software configuration file

--PathBms <std::string> : Path where Batchmake scripts are

•Options:

--nogui : If you do not need the GUI (default: 0)

--CortexLevel : Label cortex level

--idl : Label Brain level

--ids : Label Outside level

•Output :

--WorkDir <std::string> Output Directory



No Gui Mode

- In « No GUI » mode, you need to set the dataset , the configfile and the path for BatchMake Script by giving these in command line : `DTIAtlasBuilder --nogui --dataset -- configfile -- PathBms`
- The program will not display the GUI and will run automatically with the given parameters, as if you had pushed the « Compute » button.



Slicer

- You can use RodentThickness in Slicer .
- You can download Slicer on :
<http://download.slicer.org/>
- Open Slicer.
- On “Application Settings” , click on “Modules” and add the path of the executable on “Additional Module Path”.
- Close Slicer and reopen it .

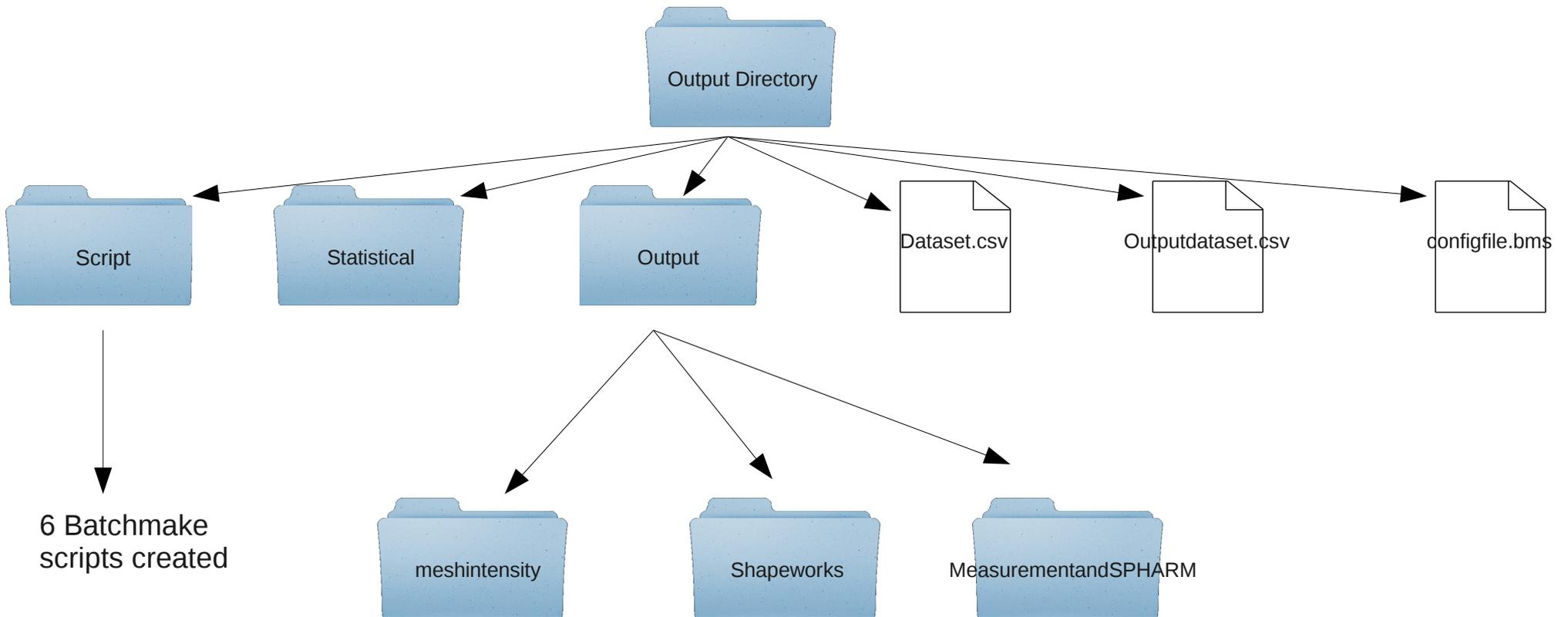
Slicer

- After added the path , click on Modules and in “All Modules “ choose “Rodent Cortical Thickness Analysis”
- You must complete four parameters:
 - dataset : CSV file containing the input
 - configfile : the configuration file for executable path
 - WorkDir : The path of the Output Directory
 - PathBms : the directory containing Batchmake script

Frequent Problem

- You will have a message box with "Item Empty" if one row are empty. Please delete the row or fill all the item of the row (except group if Statistic box is not check).
- You will have a message box with "Corrupt File" if the config file is not good, please save one for see the form and the order of the config file.
- You will have a message "Could not open csv file" if we can't read it or because the first line is not :
subjId labelMapInput group

Data organisation



Output Directory

3 Folders in the directory :

- MeasurementandSPHARM

`${subject}_measurementoutput.nrrd` : Computed thickness volume

`${subject}_para.vtk` : Mesh for the spherical parametrization

`${subject}_surf.vtk` : Mesh for the surface

`${subject}.ip.SPHARM.vtk` : output is a series of SPHARM coefficients and SPHARM-PDM meshes

`${subject}.subj.SPHARM.vtk`

- shapeworks

`${subject}.correspondence.vtk`

`${subject}.warped.vtk`

- meshintensity

`${subject}.txt`

`${subject}.sampling.vtk` : Mesh output with actual sampling points

Statistical Directory

4 files have created :

- data.{group}.txt : Table contains Value of thickness measurement for each point and each subjects of the group
- listThicknessSamplingResult_{group}.txt : File contains the path for \${subject}.txt
- stats.txt : Average of thickness measurement for each point for all the subject in the group
- stats.vtk

In the file stats.txt , you have the results :

- ctrmean : mean of thickness measurement for the first group
- exprmean : mean of thickness measurement for the second group
- t.pvalues : pvalue if the number of subject is more than 20
- w.pvalues : pvalue if the number of subject is less than 20

-

Rodent Thickness on line

- GitHub :

<https://github.com/mjacquem/RodentThickness>

NITRC :

<https://www.nitrc.org/projects/rodentthickness/>



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