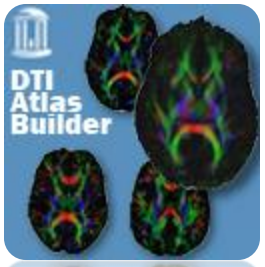
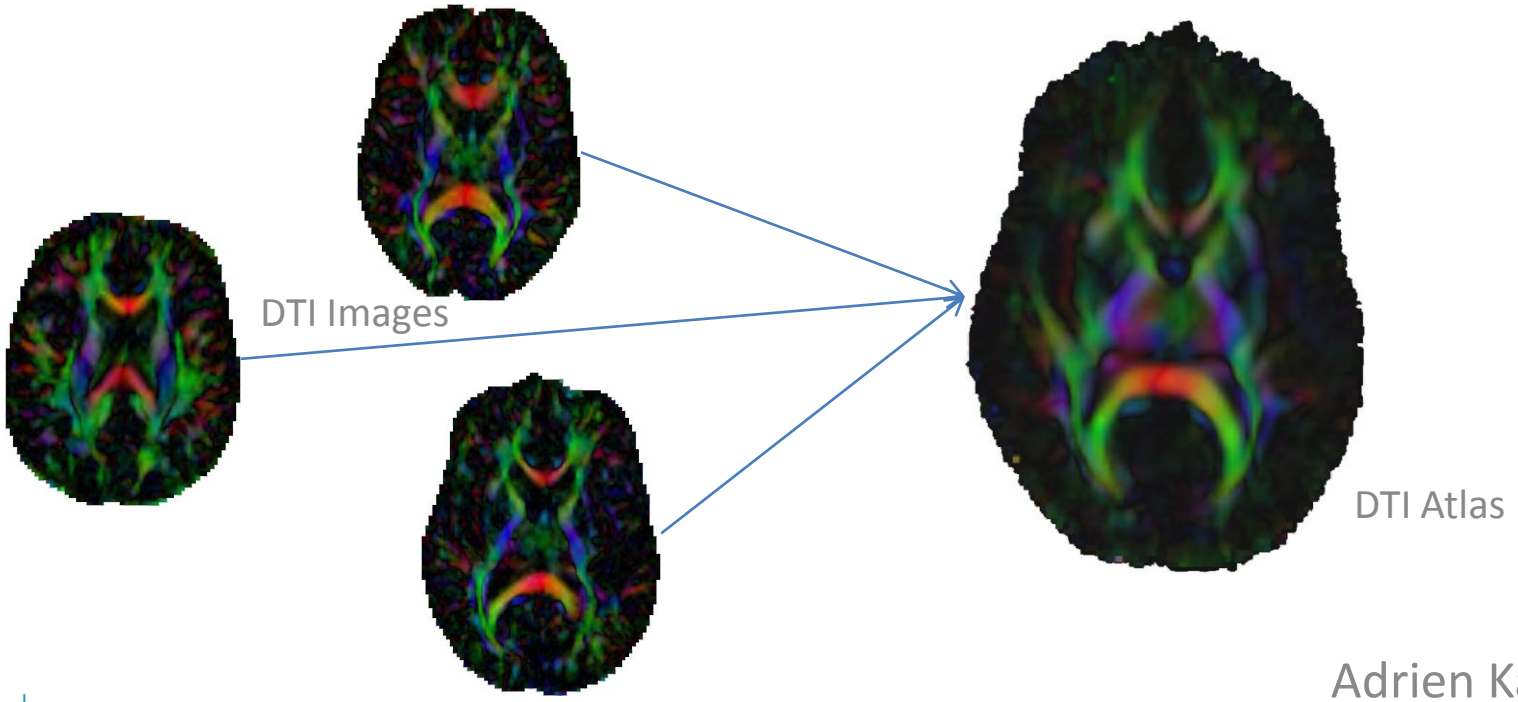


DTIAtlasBuilder

A tool to create an atlas from several DTI images



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- Framework
- Download
  - Online
  - Slicer Extension
- GUI
- Basic Use
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  - Remove DTI images
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  - Diffeomorphic Atlas
  - Final Resampling
- Load and Save
- Keyboard Shortcuts
- Quality Control
- Software Configuration
  - Manual Configuration
  - Automatic Configuration
  - Load and Save
- Command Line
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  - No GUI mode
- Grid Processing
- External Requirements
- Data Organization
- Troubleshooting

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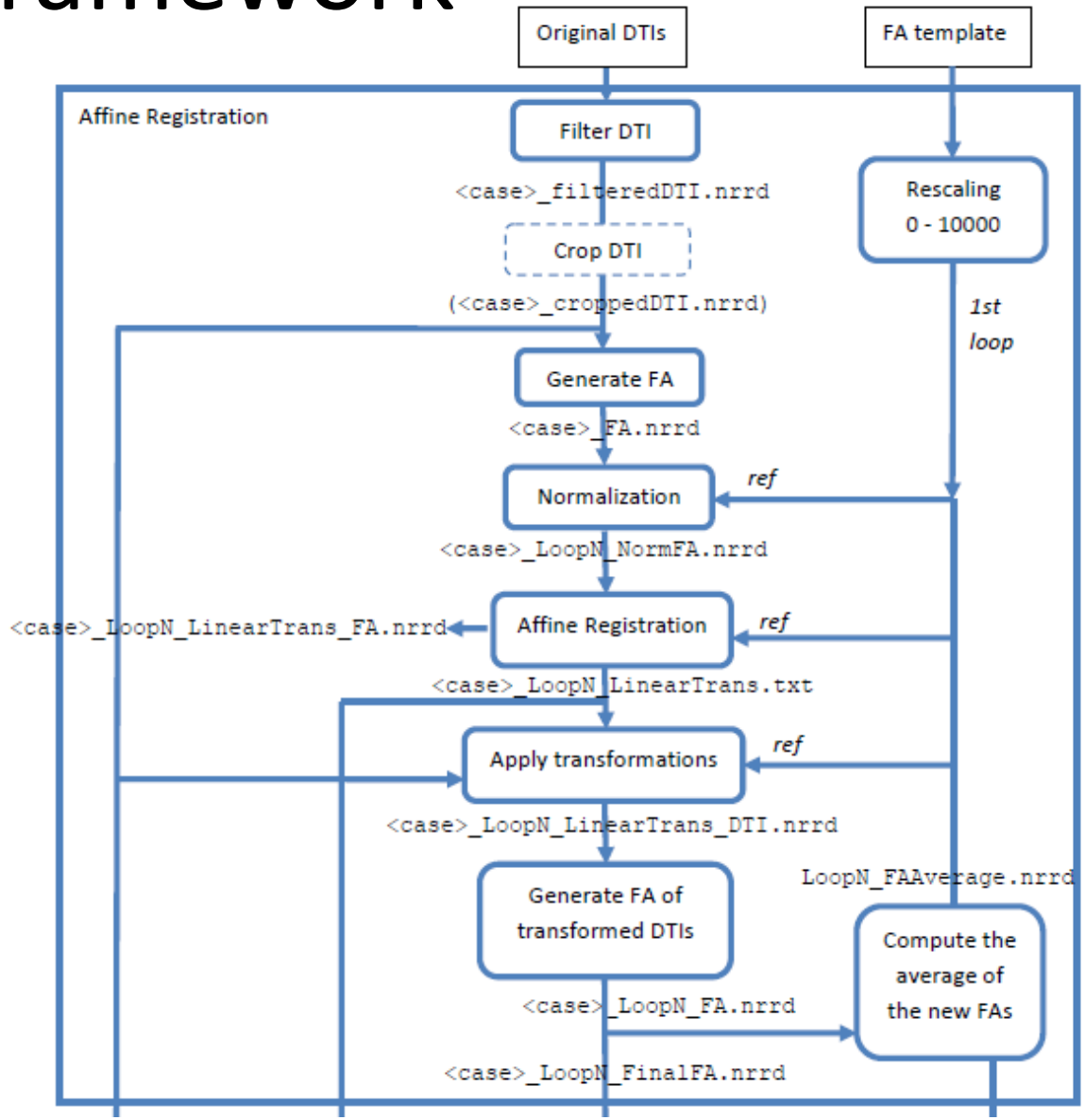
Framework

- This program will allow you to create an Atlas image as an average of several registered DTI images. The registration will be done in two steps :
  - Affine Registration with BRAINSFit
  - Non-Linear Registration with GreedyAtlas
- A final step will compute the final Atlas by resampling and averaging the registered images.

Framework

- Affine Registration Pipeline

- The Affine Registration can be done in several loops. At each loop, the normalization and the registration will be done with a new reference, to improve the quality. The reference is the first case or a template you gave for the first loop, and then an average computed at the end of the loop.



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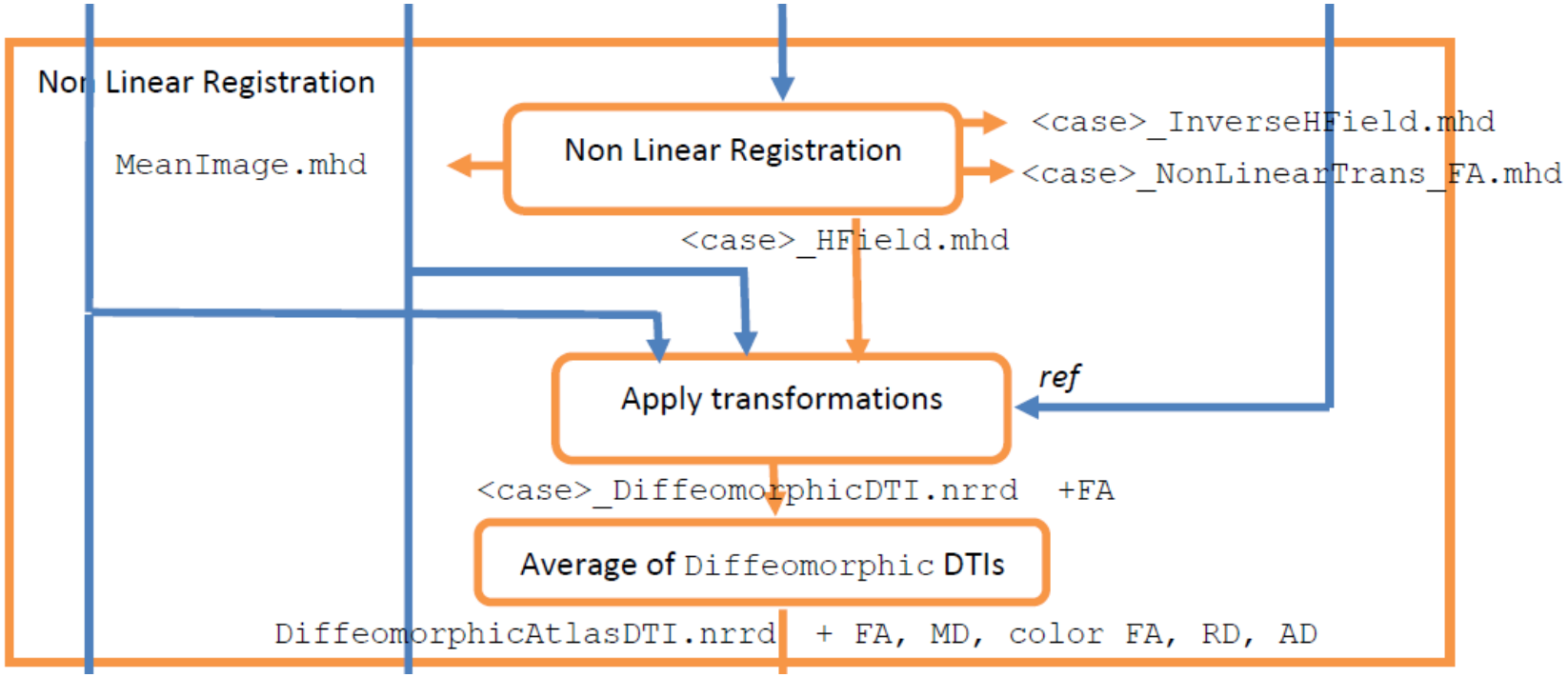
Framework

- AtlasBuilding Pipeline : Non Linear Registration



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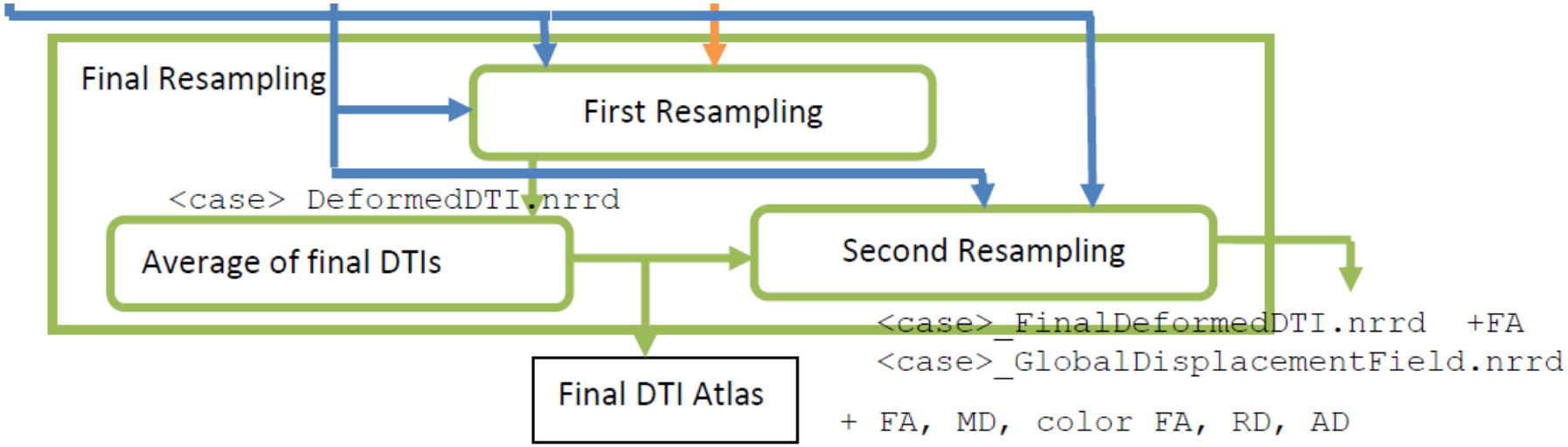
Framework

- Final Resampling Pipeline



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Online

- Source Code: GitHub: http://github.com/NIRALUser/DTIAtlasBuilder
  - To get the source code from a linux shell:

```
$ git clone http://github.com/NIRALUser/DTIAtlasBuilder.git
$ git checkout v1.3
```

- Binary package: NITRC: http://www.nitrc.org/projects/dtiatlasbuilder
  -> Downloads: Release v1.3

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Slicer Extension

- Slicer: http://www.slicer.org/

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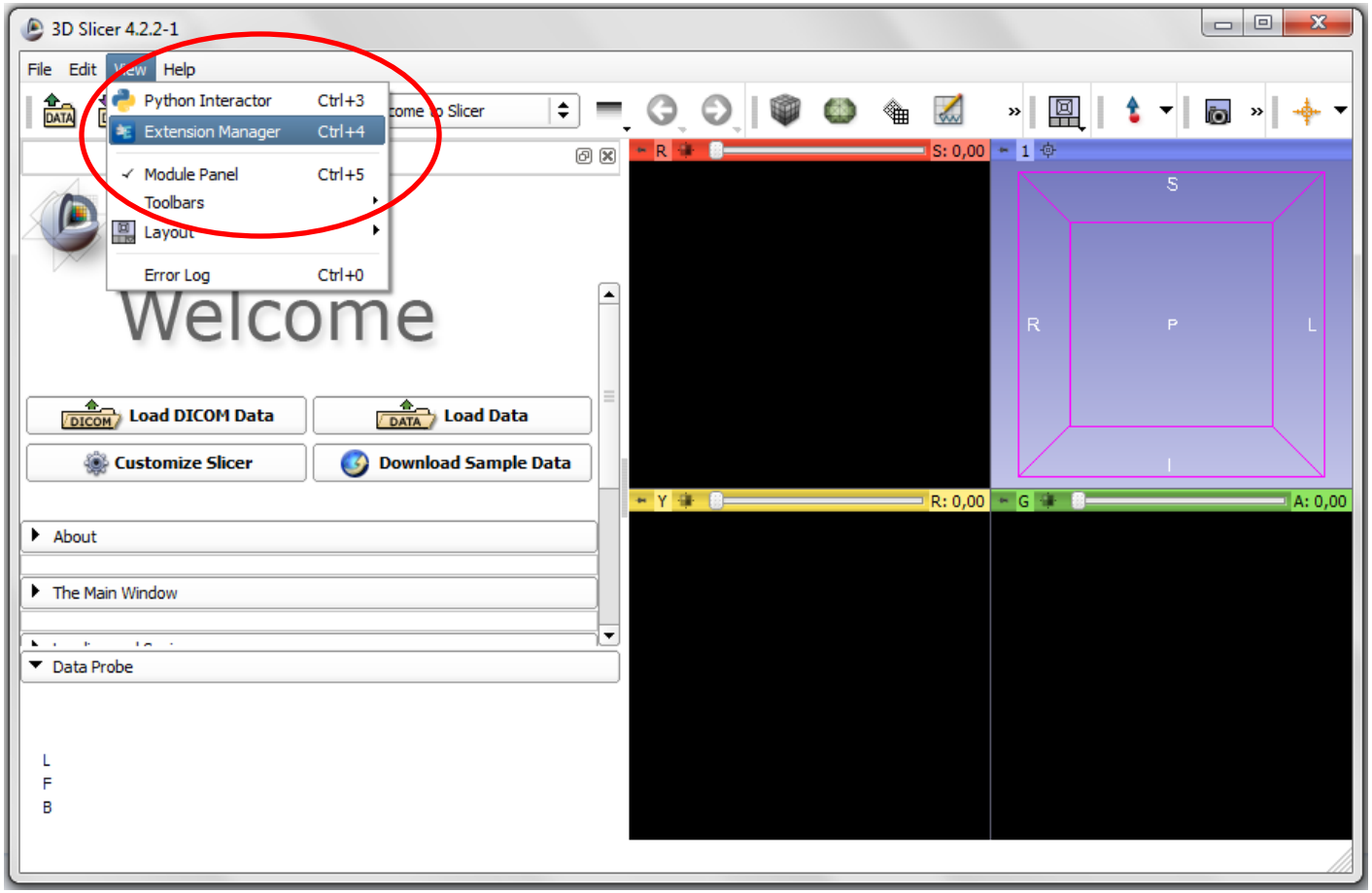
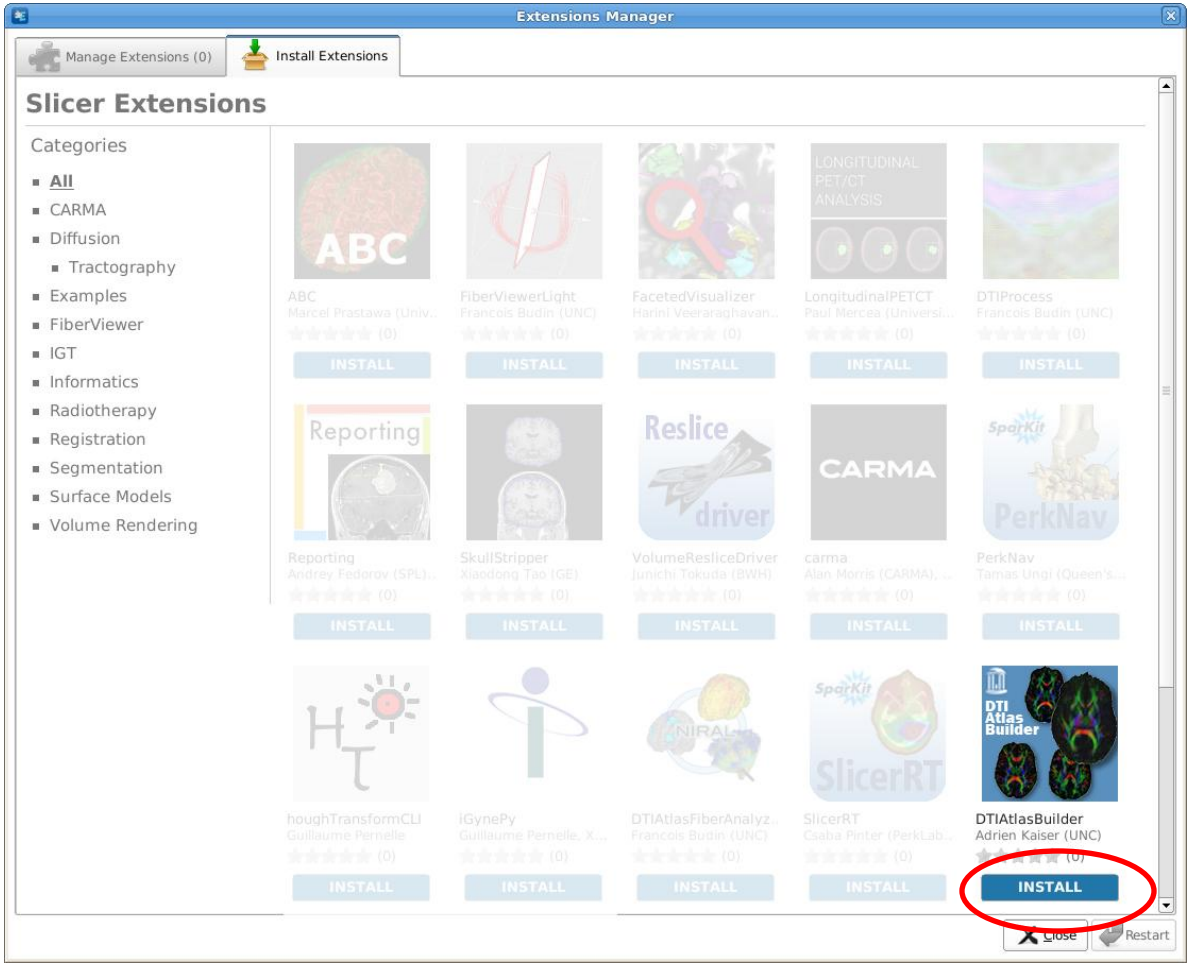
Slicer Extension



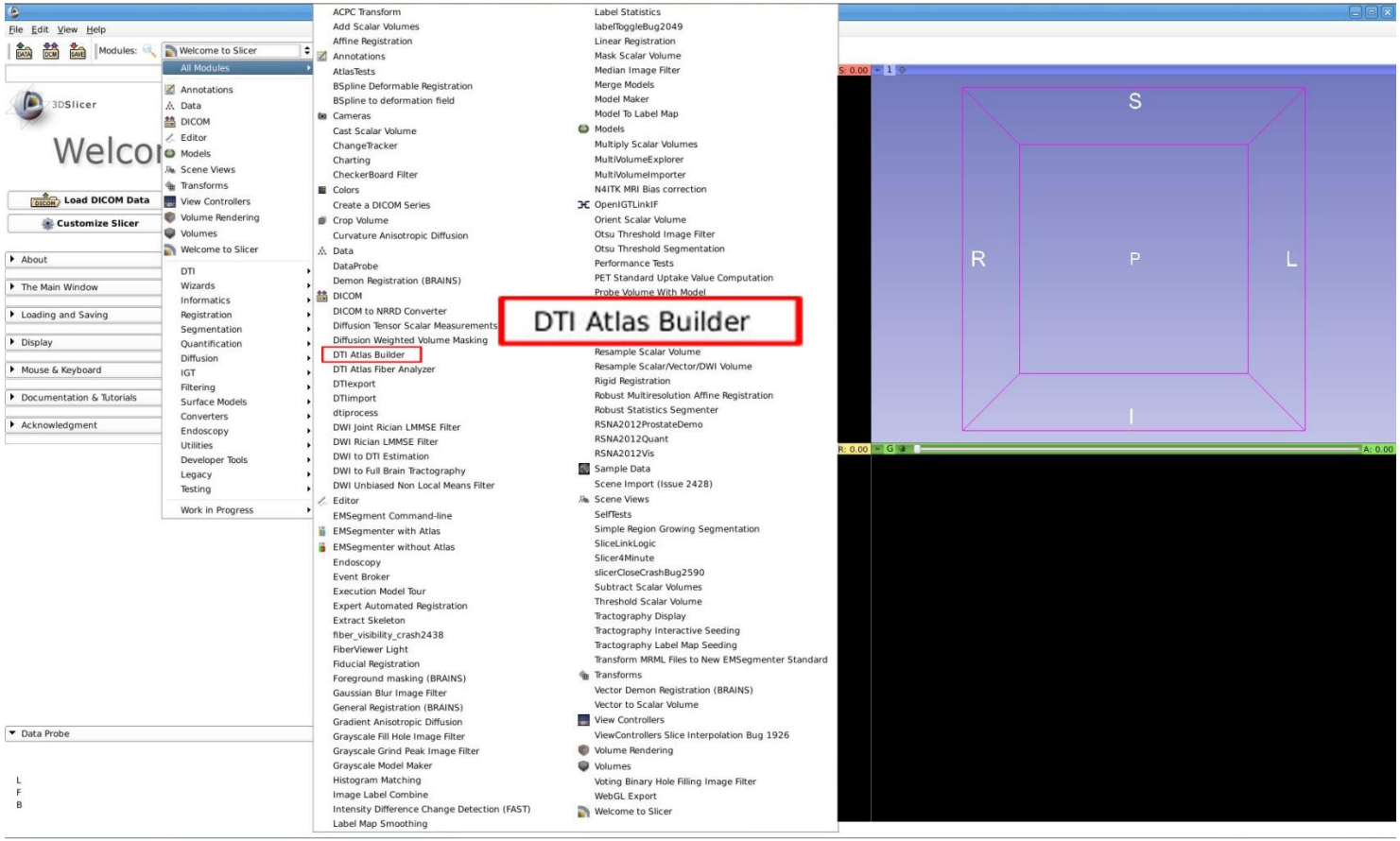
- Open the Extension Manager in **View -> Extension Manager**

Slicer Extension

- Click the blue INSTALL button under DTIAtlasBuilder
- The extension will be downloaded and you will need to restart Slicer.
- When restarted, you will find the installed extension in the module list.



Slicer Extension



- You will now find the DTIAtlasBuilder just installed in the list of all modules. Running the DTIAtlasBuilder extension will open GUI that you will use as if it was used by itself.

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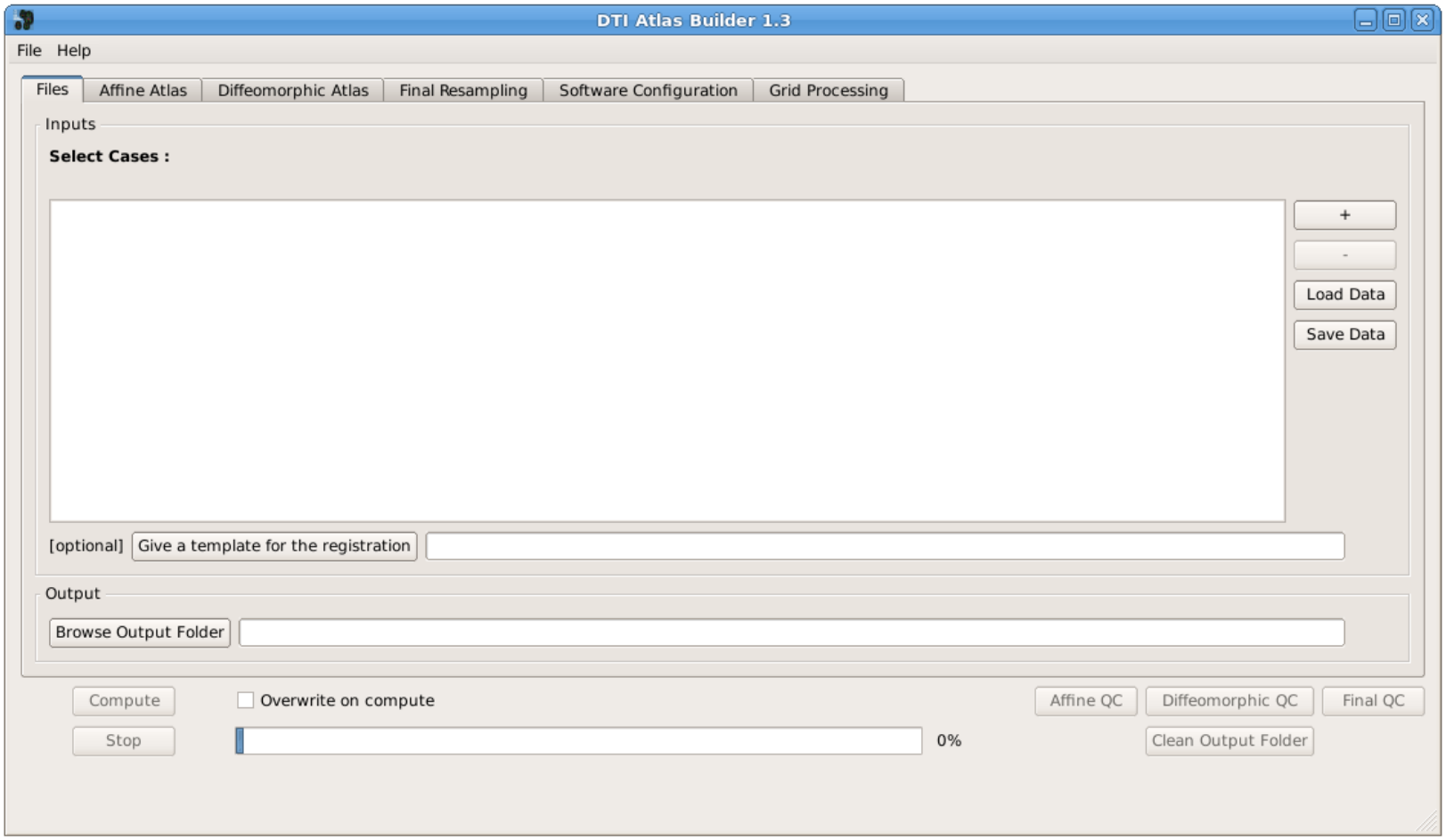
GUI



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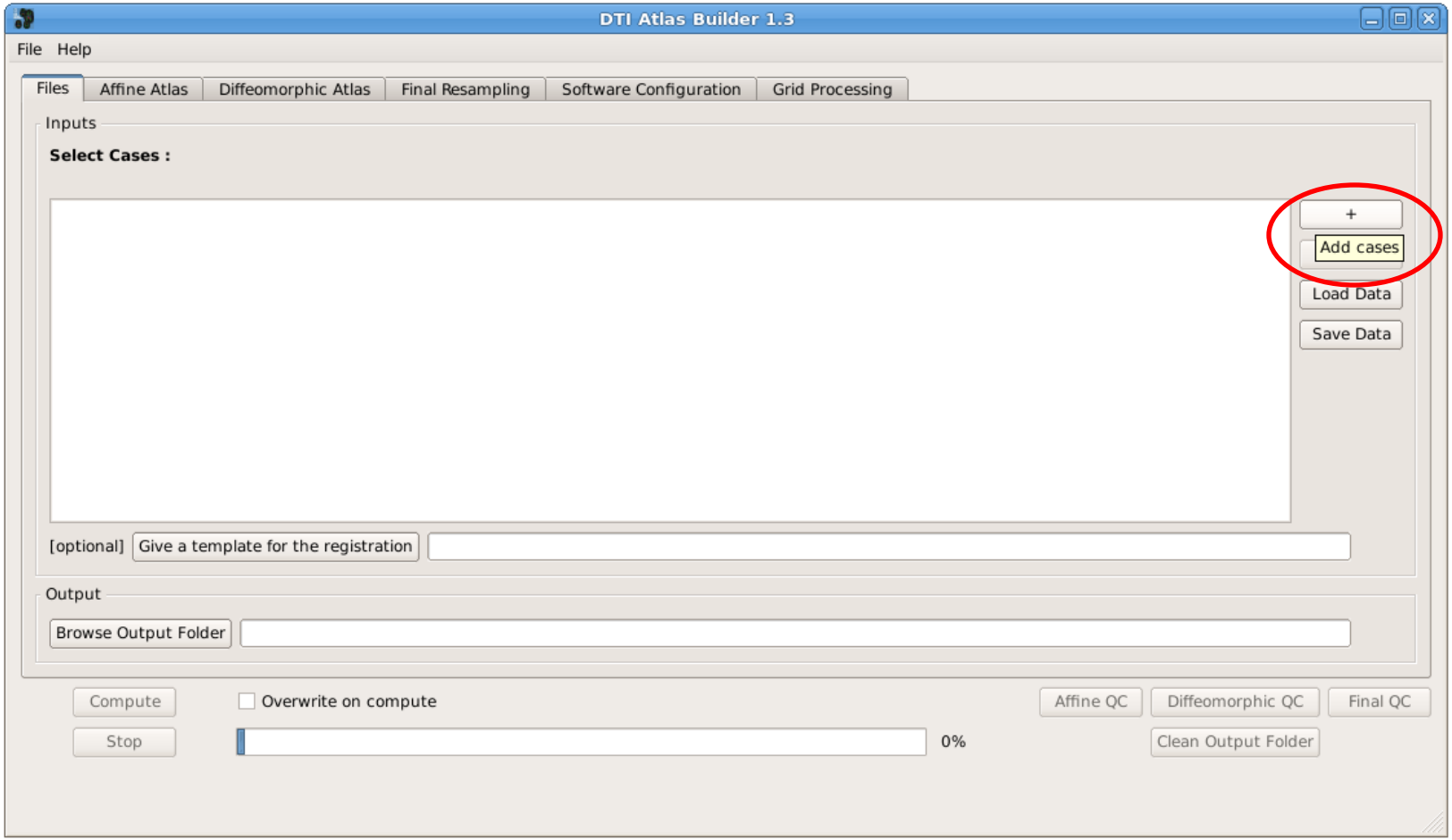
Add DTI Images



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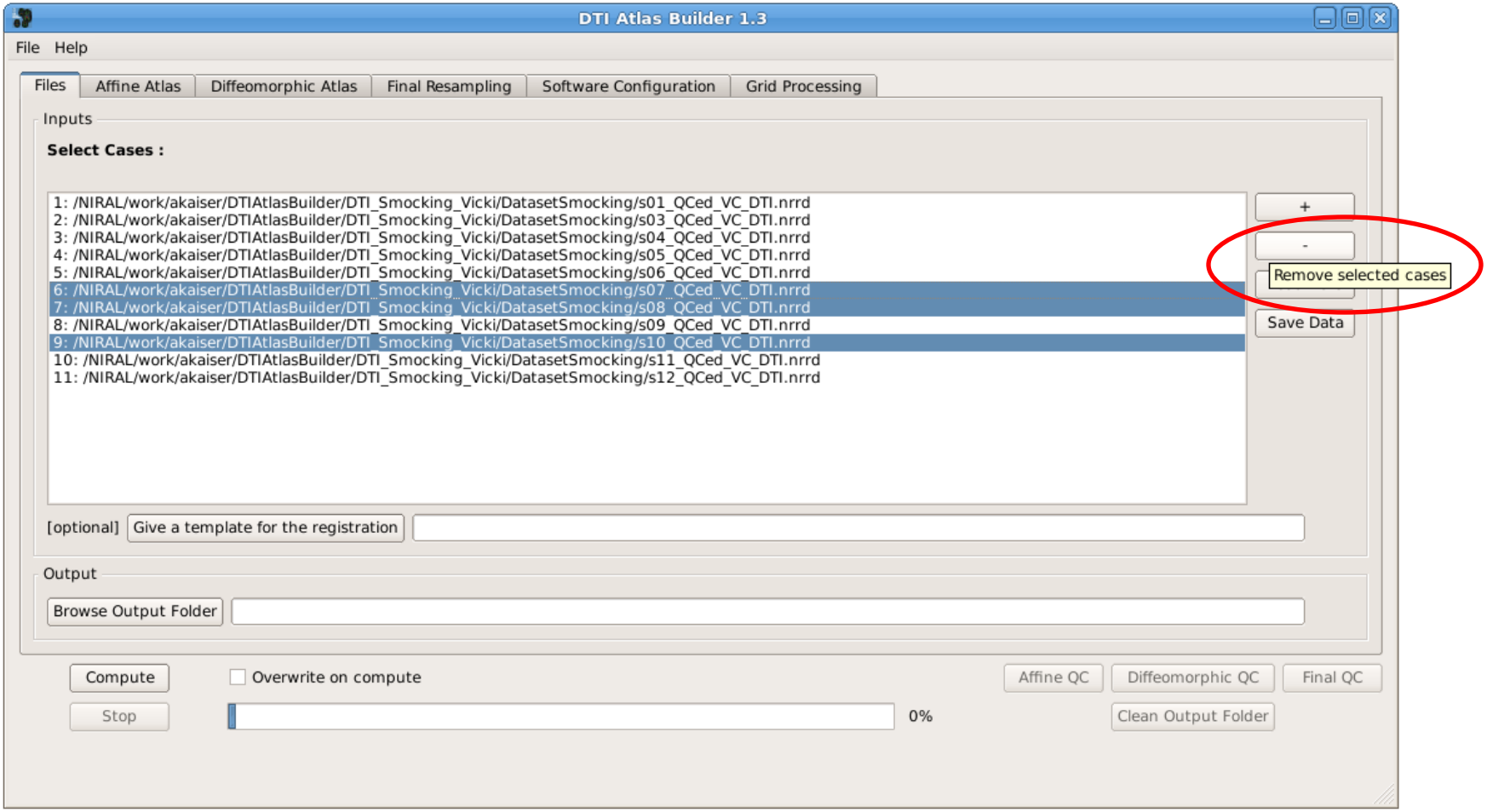
- Clicking the '+' button will allow you to select several DTI images, and add it to the central Cases box

Remove DTI Images



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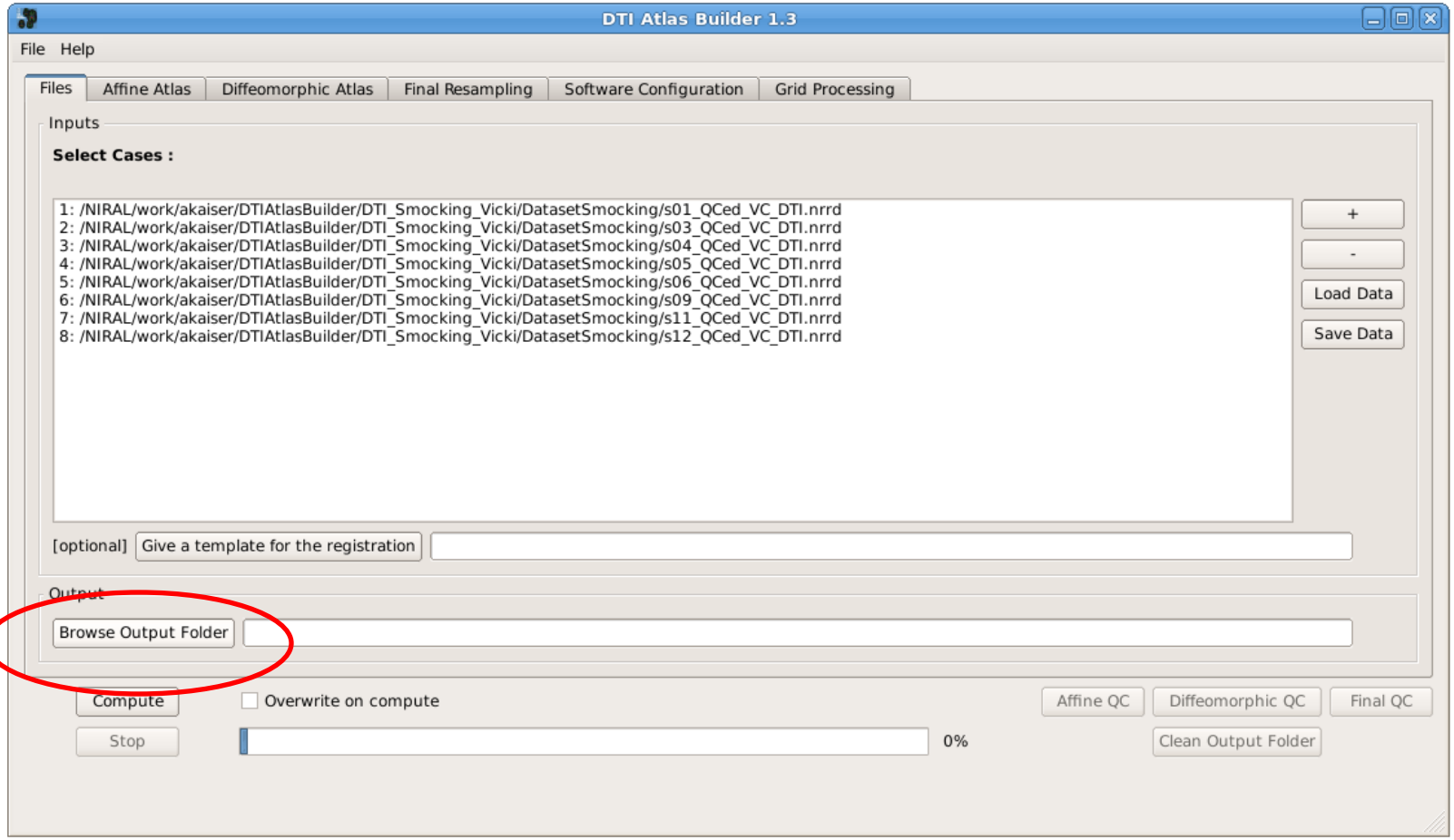
- After having selected some images, you can remove them from the central Cases box by clicking the '-' button

Give an output folder



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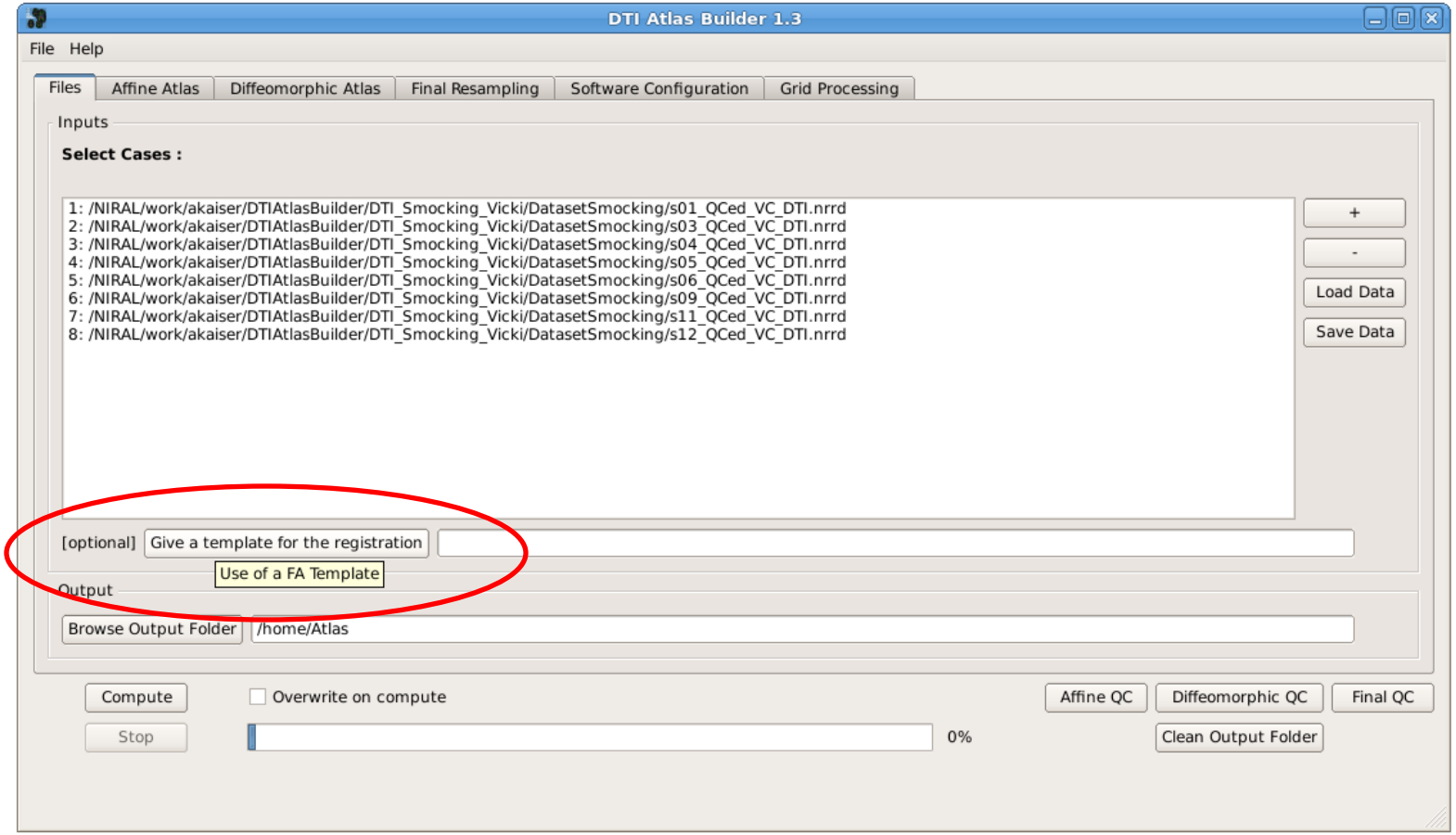
- You need to give an output folder: A folder named "DTIAtlas" will be created in your output folder, and all the files generated by the program will be put in it (Data organization on slide 33)

Optional : Give a FA Template

- As an option, you can give a scalar image (FA) as a template that will be used as reference for the affine registration with BRAINSFit in the first loop.
- The values in this template image will be rescaled between 0 and 10 000 to avoid compatibility issues
- If you do not give a template, the reference for the registration will be the first case, and then the FA average if there are loops.

Optional : Give a FA Template



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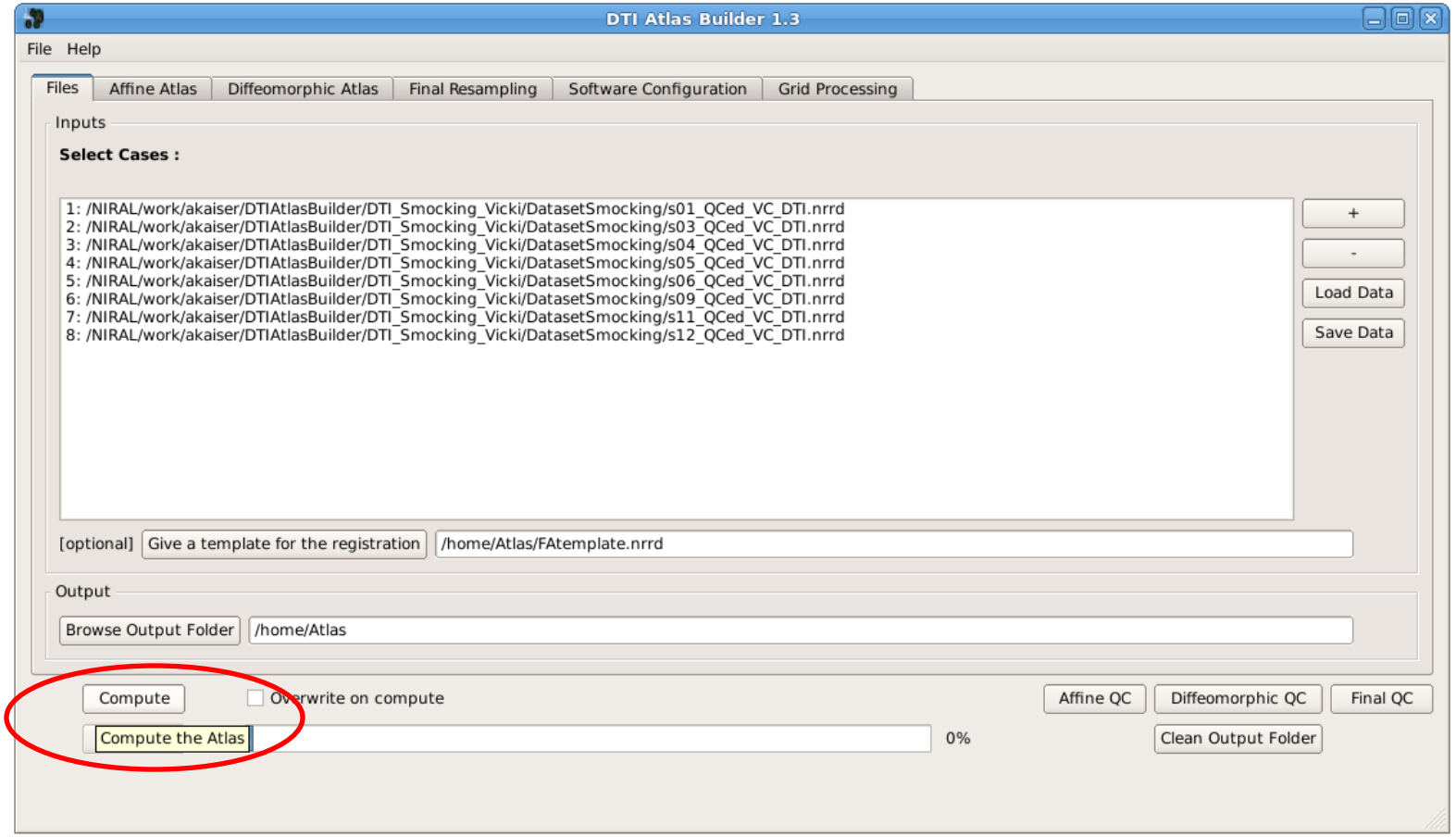
Compute the Atlas



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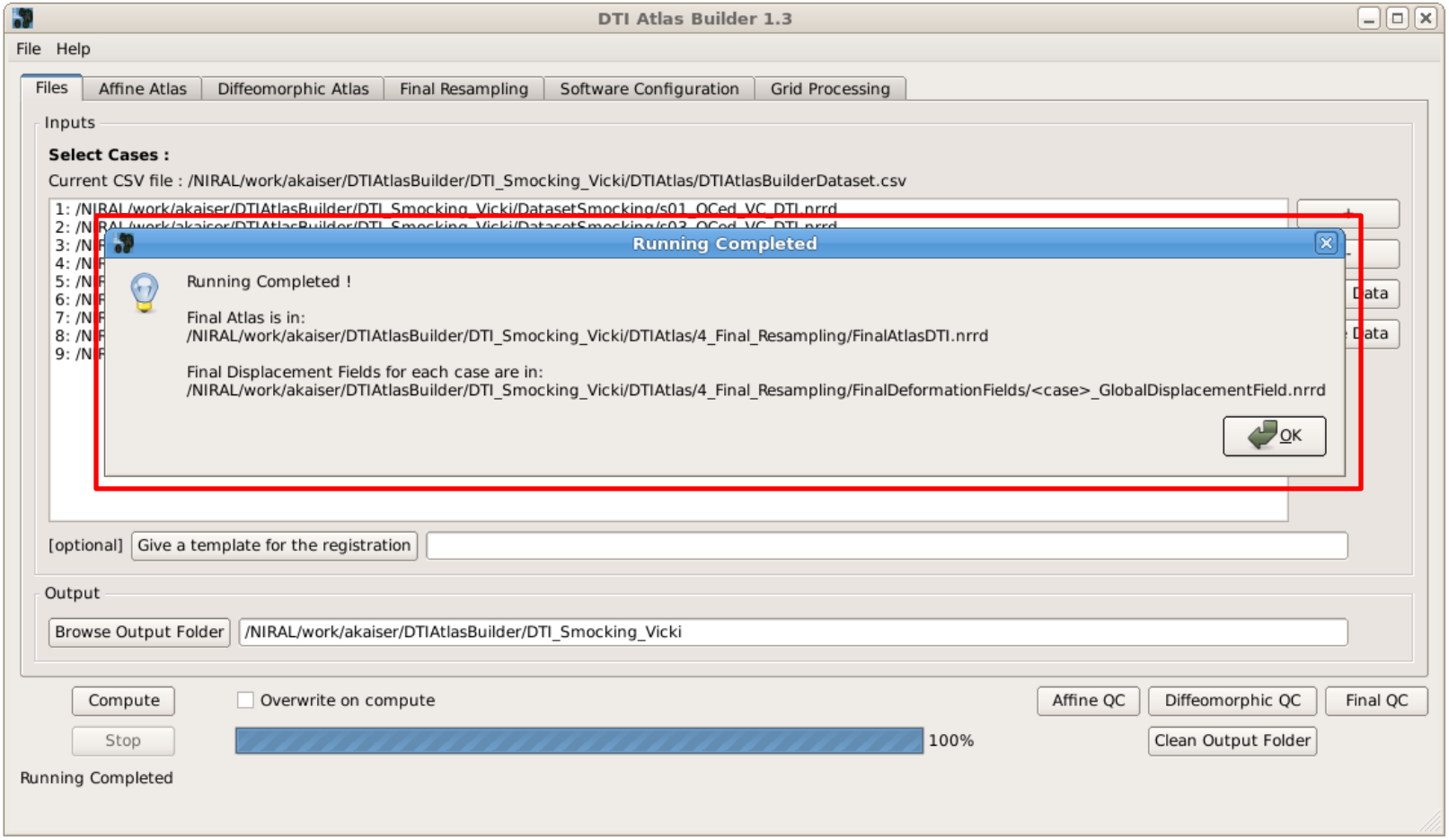
- When you added cases and gave an output folder, you can compute the Atlas by clicking the "Compute" button. It will test the existence and type of the files and the folders and tell you if some files are not images or DTIs.

Running Completed



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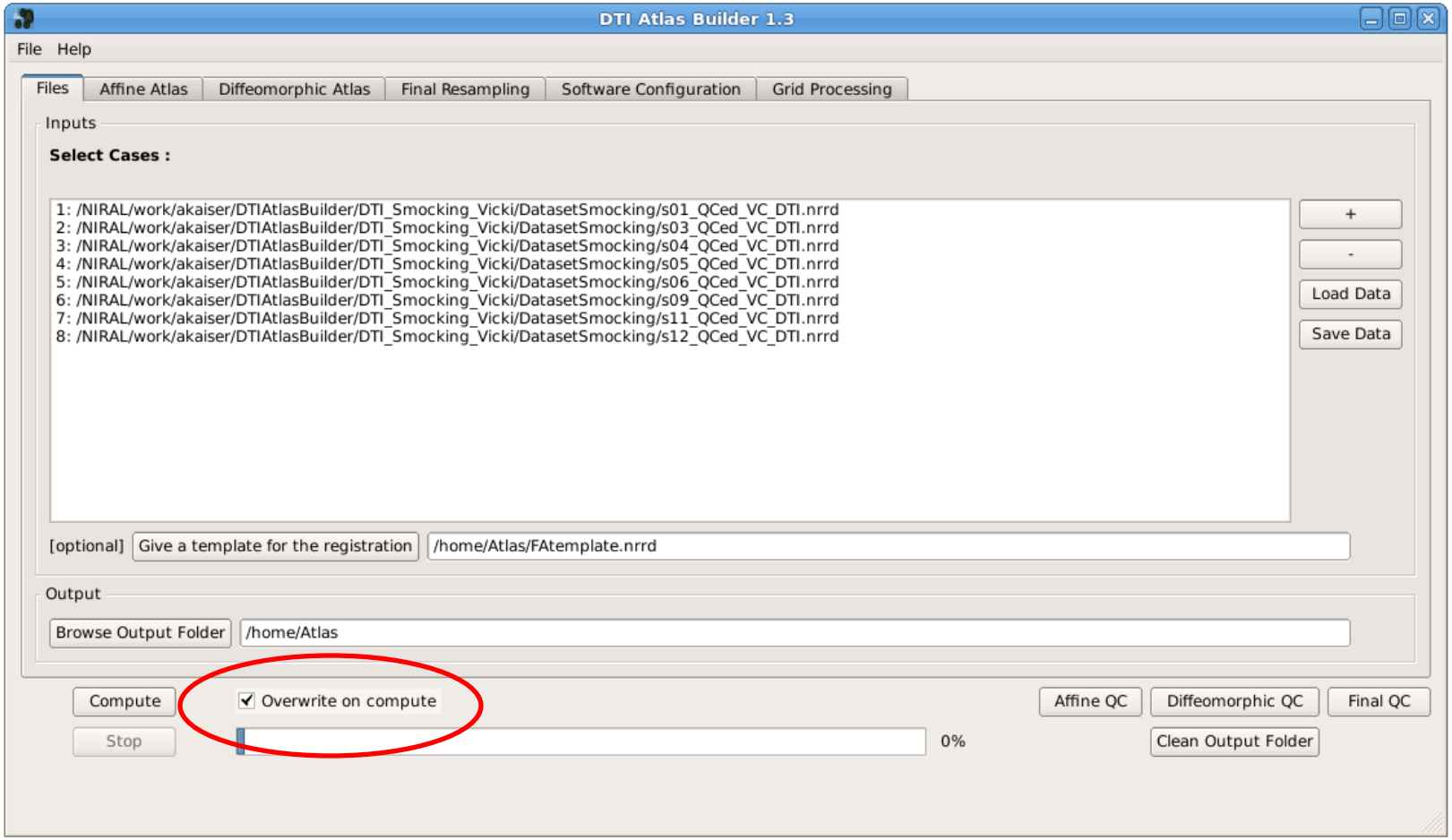
- This popup window will appear when the processing is done.

Overwriting



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- The "Overwrite" option will allow you write the images anyway, over existing images if they were computed already.

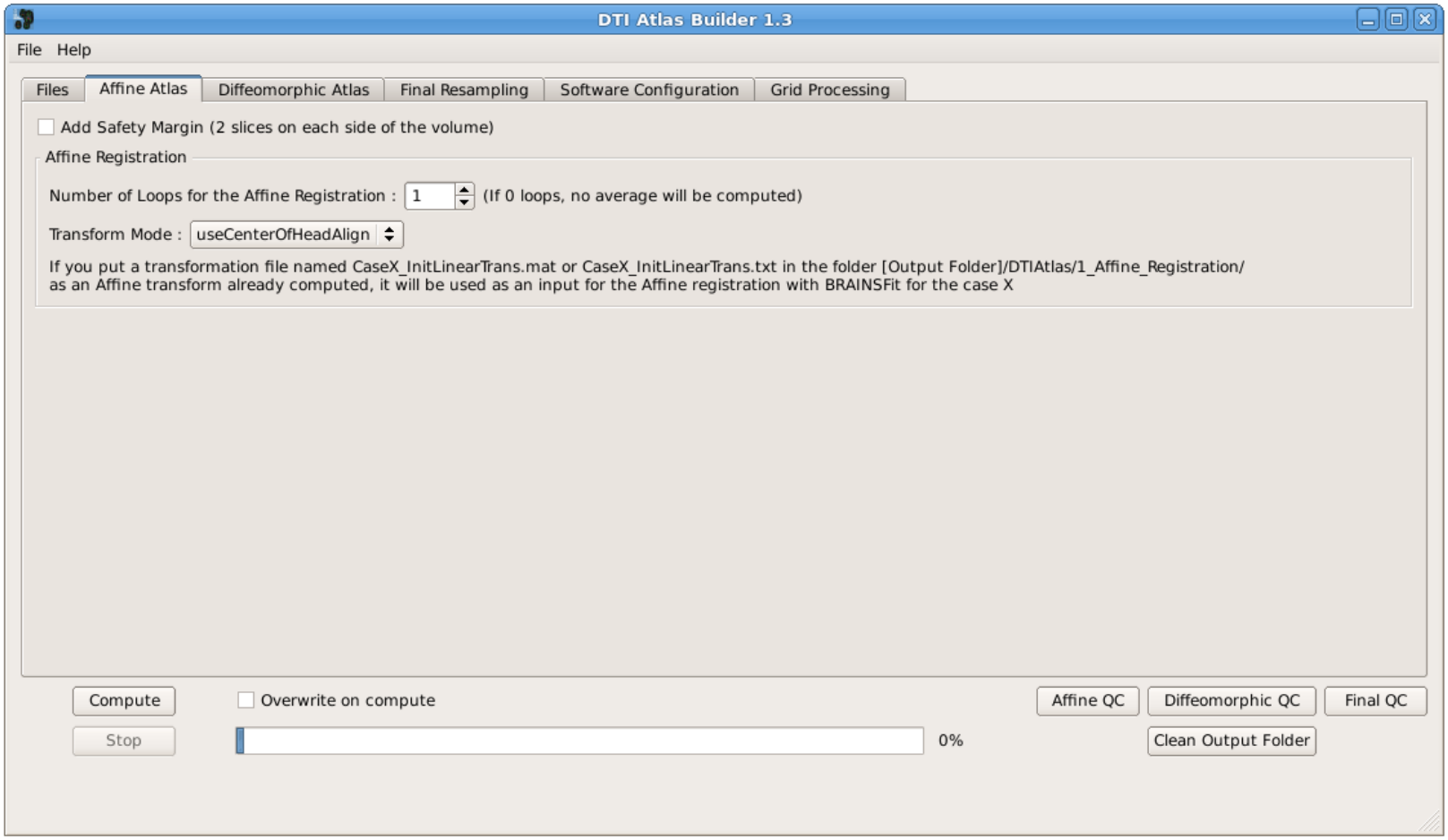
Affine Atlas

- Safety Margin : Add 2 slices at each side of the volume

- Initial Affine Transform :

  If you put a transformation file named `<case>_InitLinearTrans.txt` or `<case>_InitLinearTrans.mat` (`<case>` being the name of the corresponding original DTI image without path and extension) in the folder `[OutputFolder]/DTIAtlas/1_Affine_Registration/` as an affine transform already computed, it will be used as an input to initialize the affine registration with BRAINSFit

Affine Atlas



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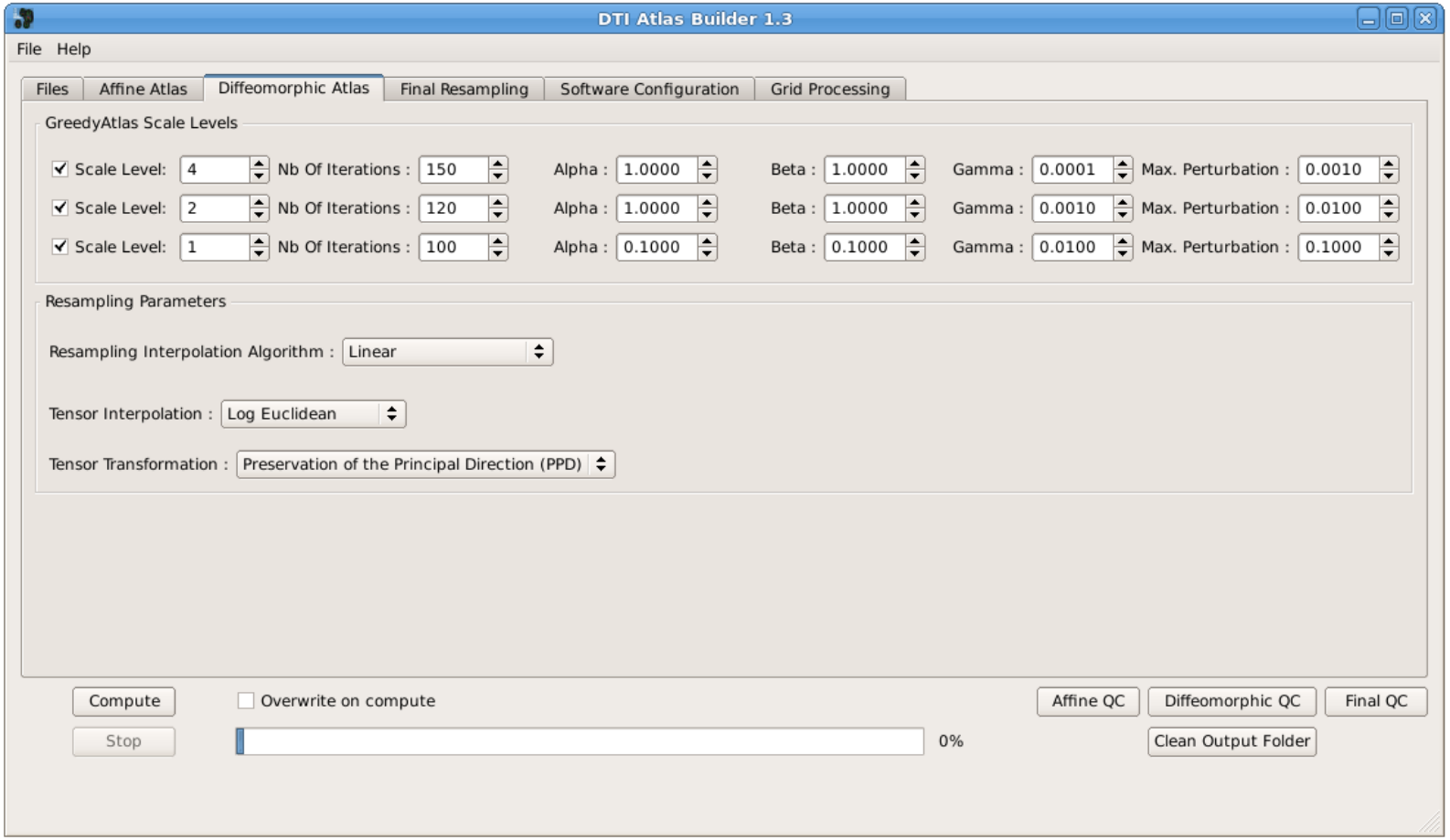
Diffeomorphic Atlas

- The Diffeomorphic Atlas is the Atlas computed from the affine registered images to get the deformation fields from the affine space to the final atlas space.
- These deformation fields will be applied to the original DTIs which will be used to compute the first DTI average.

- You can choose the Scale Levels that you want for GreedyAtlas and also the options for the resampling and for the average computation.

Options

Diffeomorphic Atlas



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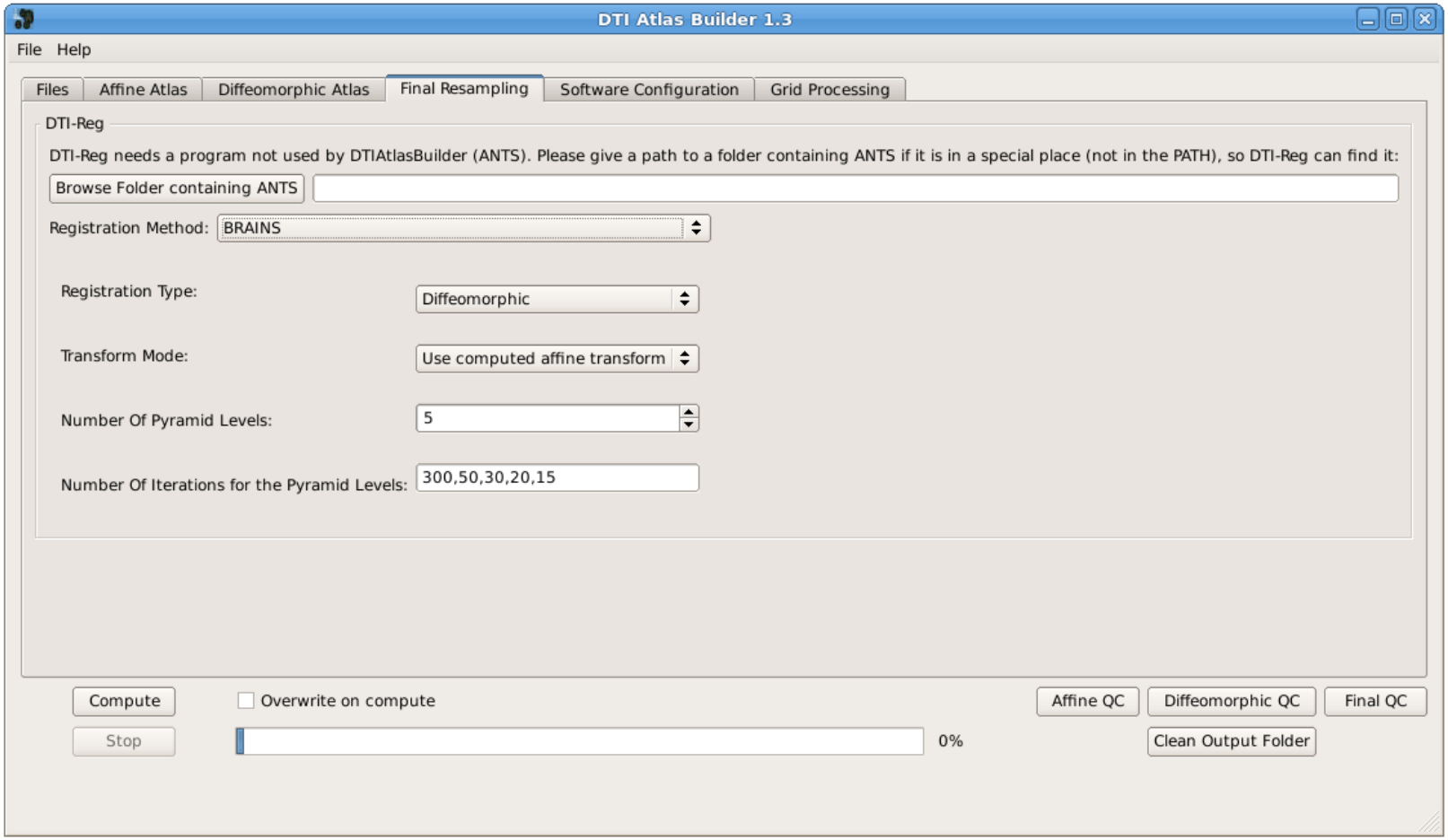
Final Resampling



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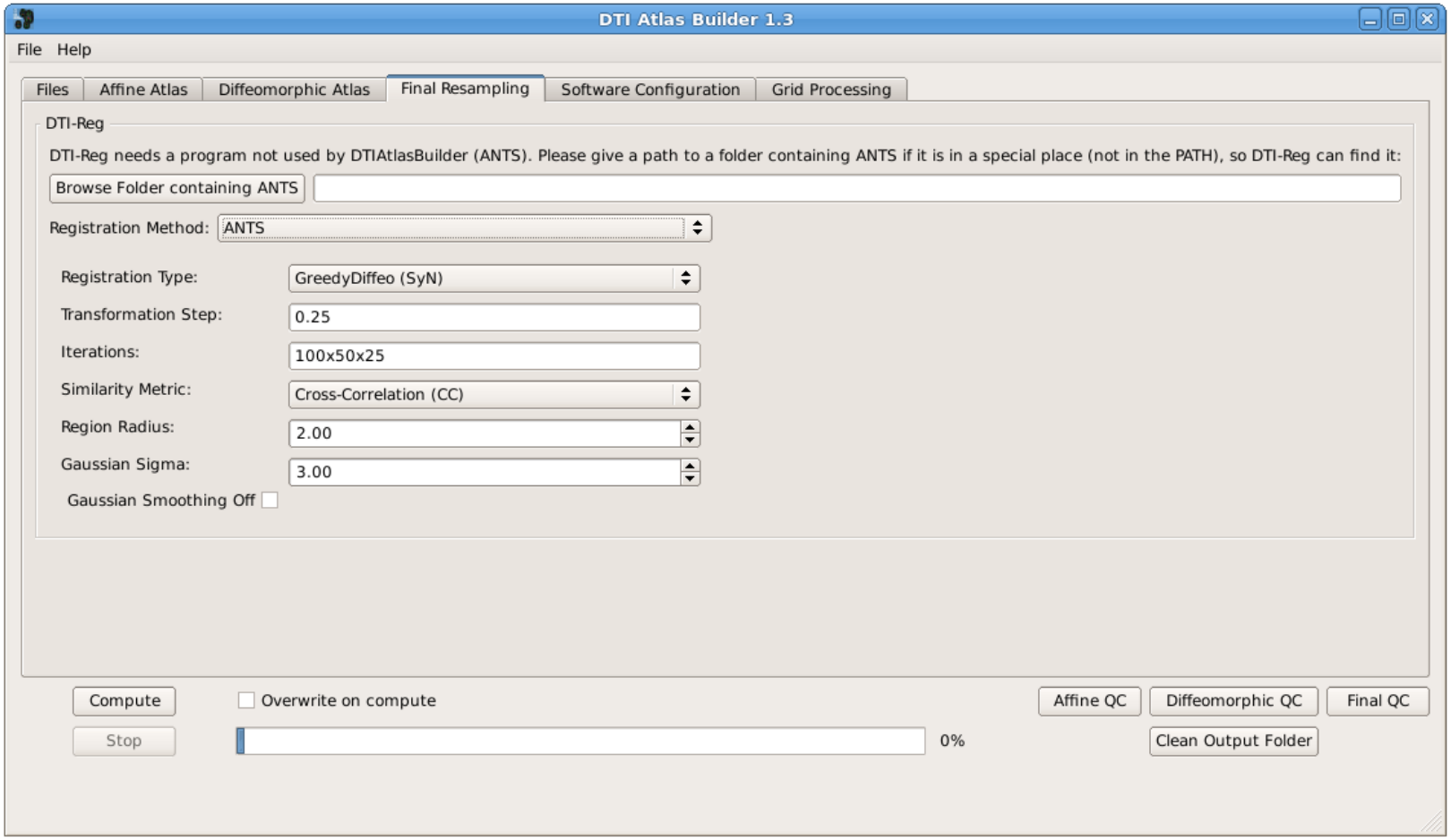
- The Final Resampling will be done with DTI-Reg, it will create the global deformation fields from the original space to the final atlas space. You can use either BRAINS or ANTS, and you can also choose your options.

Final Resampling



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Load and Save

- Save your parameters: In the « File » Menu, you can Save or Load a parameter file generated by the program. Do not change the parameter file manually, because it could be recognized by the program as a corrupt file and not be read.
- When you save the parameters, a .csv file with the dataset will automatically be created in the same directory than the parameter file.

- Auto save: When you push the « Compute » button, the program will automatically save a parameter file (`DTIAtlasBuilderParameters.txt`) and a .csv dataset file (`DTIAtlasBuilderDataset.csv`) in `[OutputFolder]/DTIAtlas`.

  It will also save a .csv file with the paths to all the interesting files generated, in this same folder (`DTIAtlasBuilderResults.csv`).

- You can save your Dataset into a CSV file so you can load it and use it again later.
- You can also load a CSV file containing paths to a Dataset you saved before or you wrote yourself with this format:

```
id,Original DTI Image
1,/home/Dataset/DTI_1.nrrd
2,/home/Dataset/DTI_2.nrrd
3,/home/Dataset/DTI_3.nrrd
4,/home/Dataset/DTI_4.nrrd
5,/home/Dataset/DTI_5.nrrd
6,/home/Dataset/DTI_6.nrrd
7,/home/Dataset/DTI_7.nrrd
8,/home/Dataset/DTI_8.nrrd
9,/home/Dataset/DTI_9.nrrd
.,...
.,..
.,.
```

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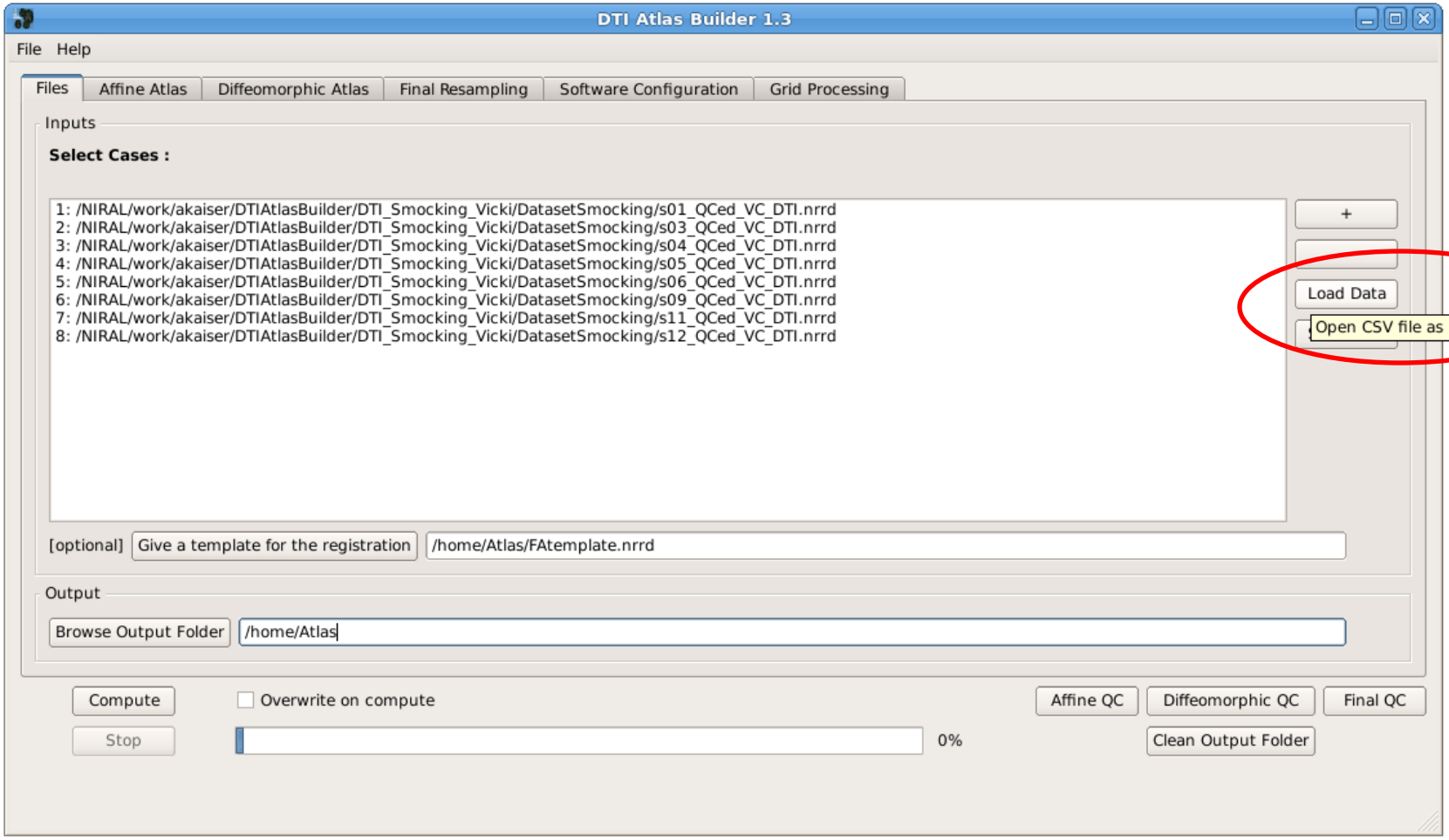
Load and Save



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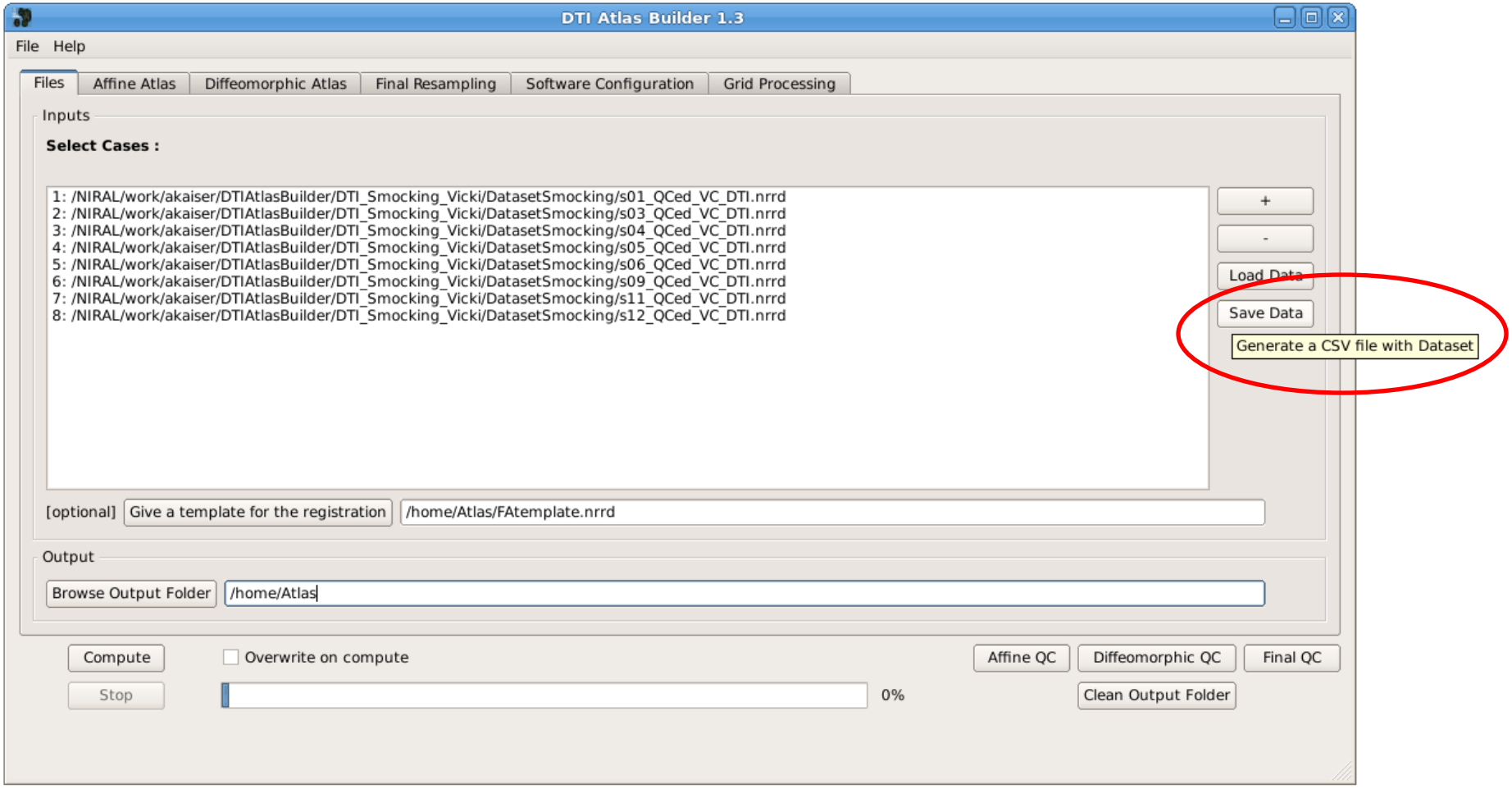
Load and Save



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Keyboard Shortcuts

- RETURN or ENTER: Compute
- PLUS: Add cases
- MINUS or DELETE: Remove cases

- It is also possible to drag and drop any file (DTI image, dataset CSV file, software configuration file or parameter file) into the window to be loaded.

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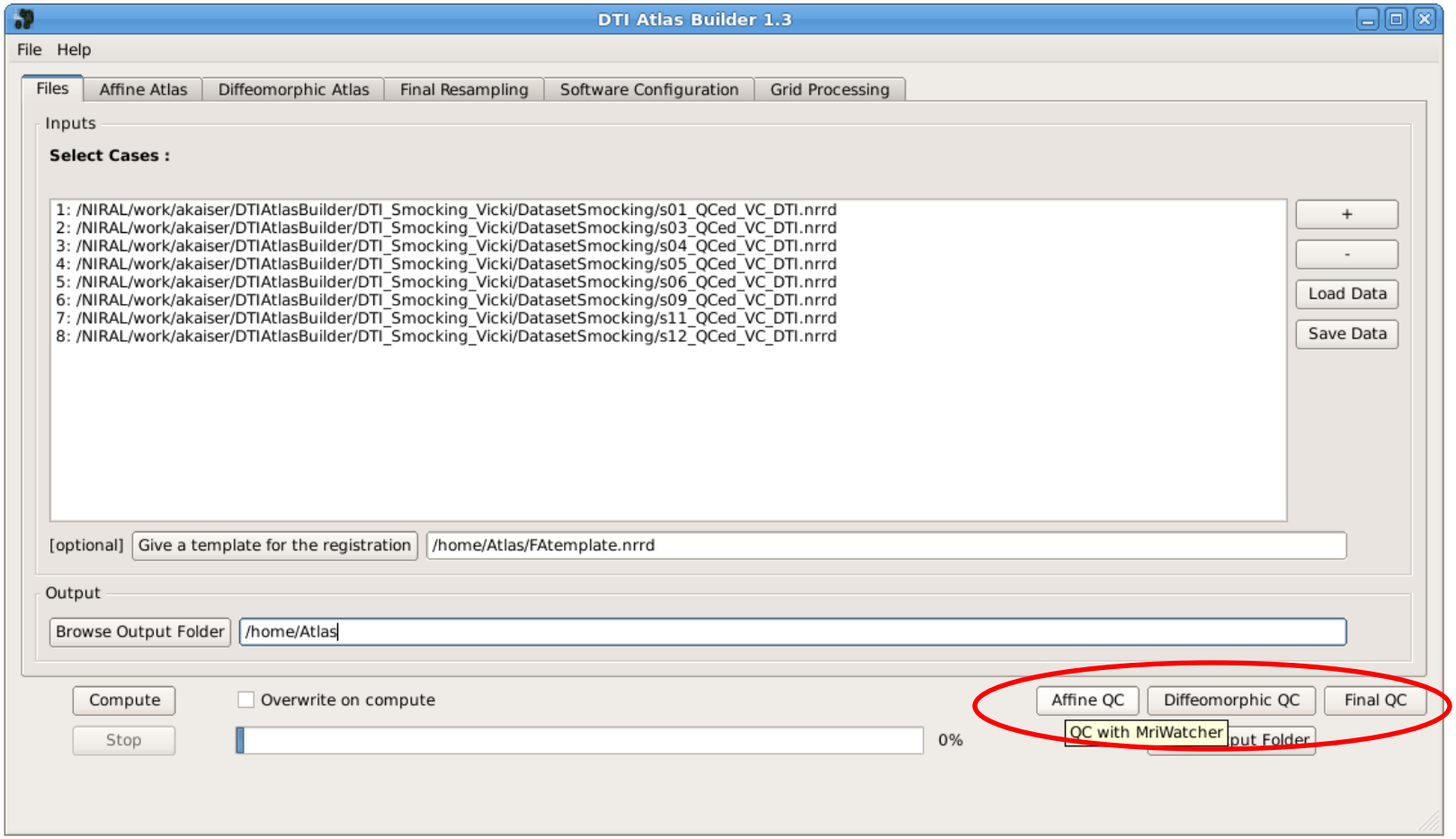
Quality Control



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- By pushing one of the QC buttons, you will run MriWatcher to see the images at different steps of the compute, and check if the results are good.

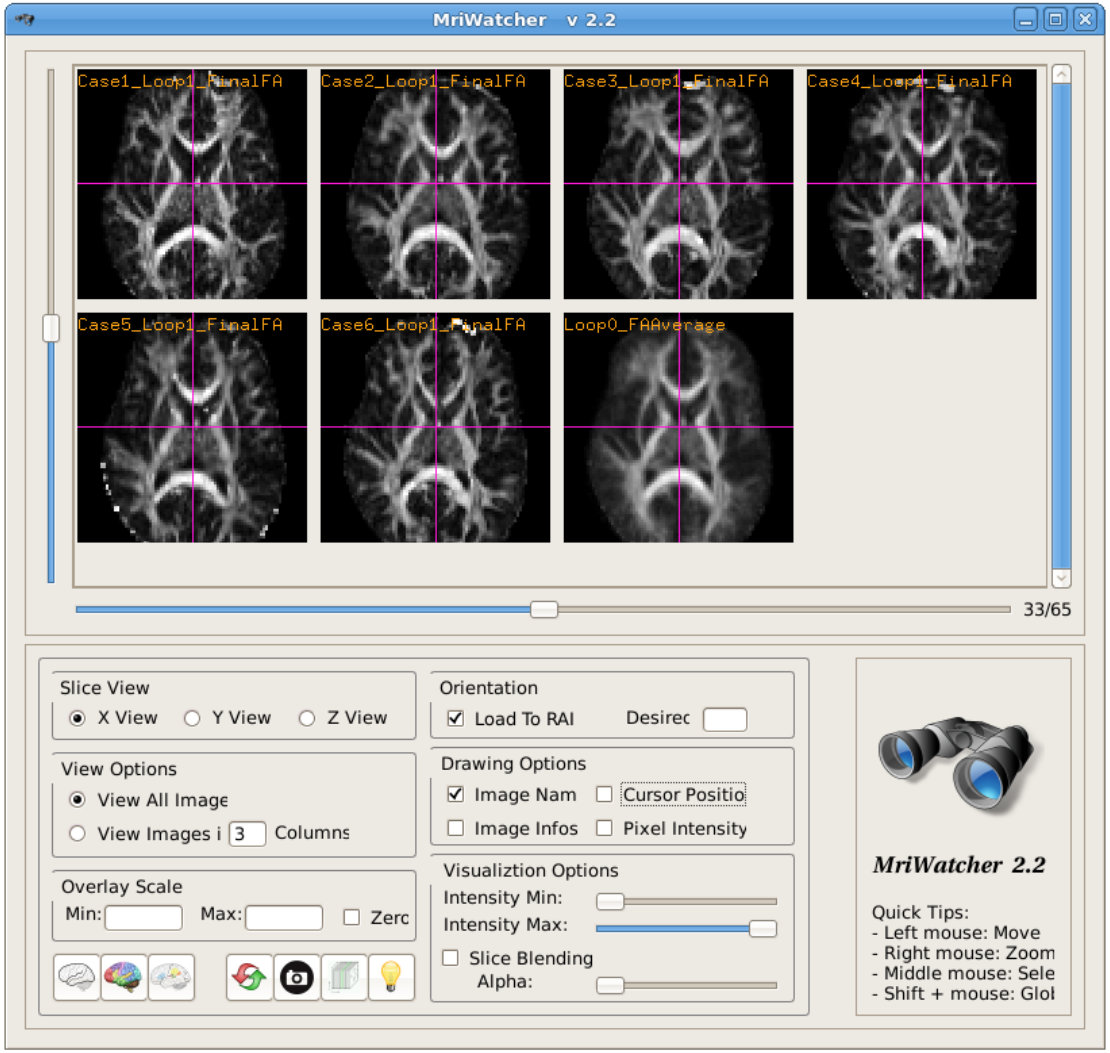
Quality Control

- Affine QC:

  Affine registered FAs and last affine average computed
- Deformable QC:

  Deformably registered FAs and Diffeomorphic Atlas
- Final QC:

  Final DTI-Reg resampled FAs and final Atlas



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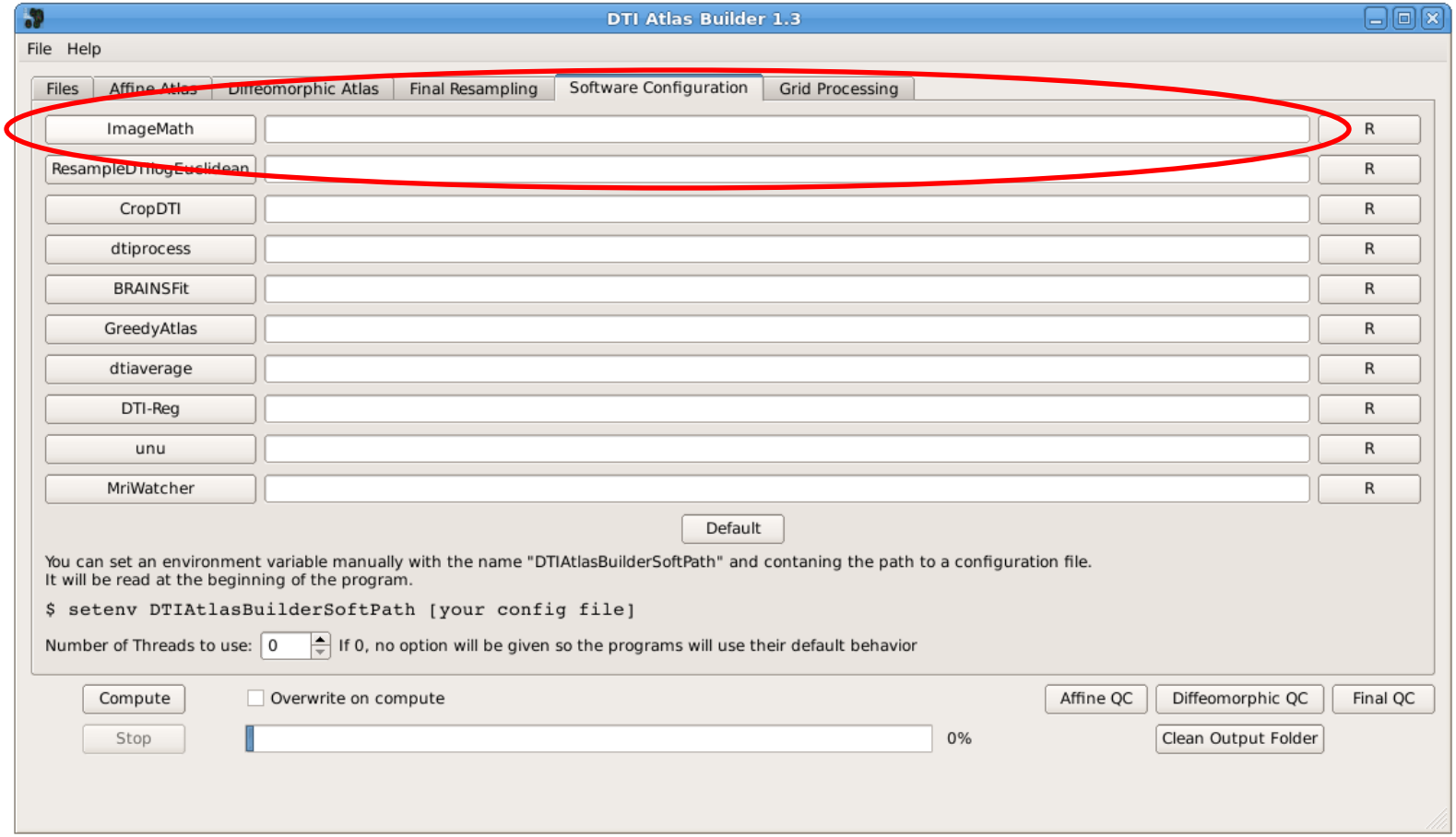
Manual Configuration



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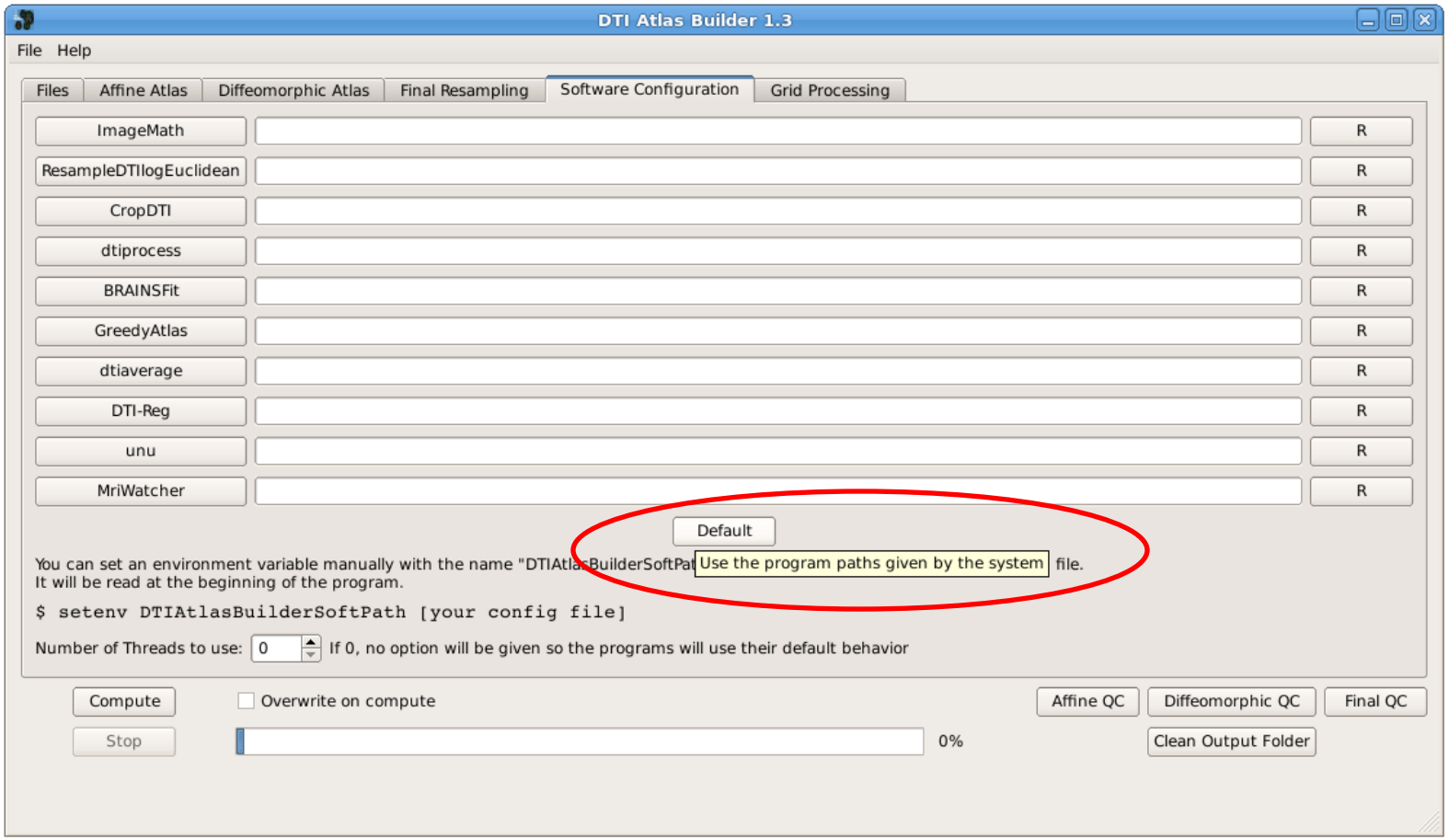
- If you have your own version of the programs or if you need to use a particular version of it, you can write the path manually or click the button to search it.

Automatic Configuration



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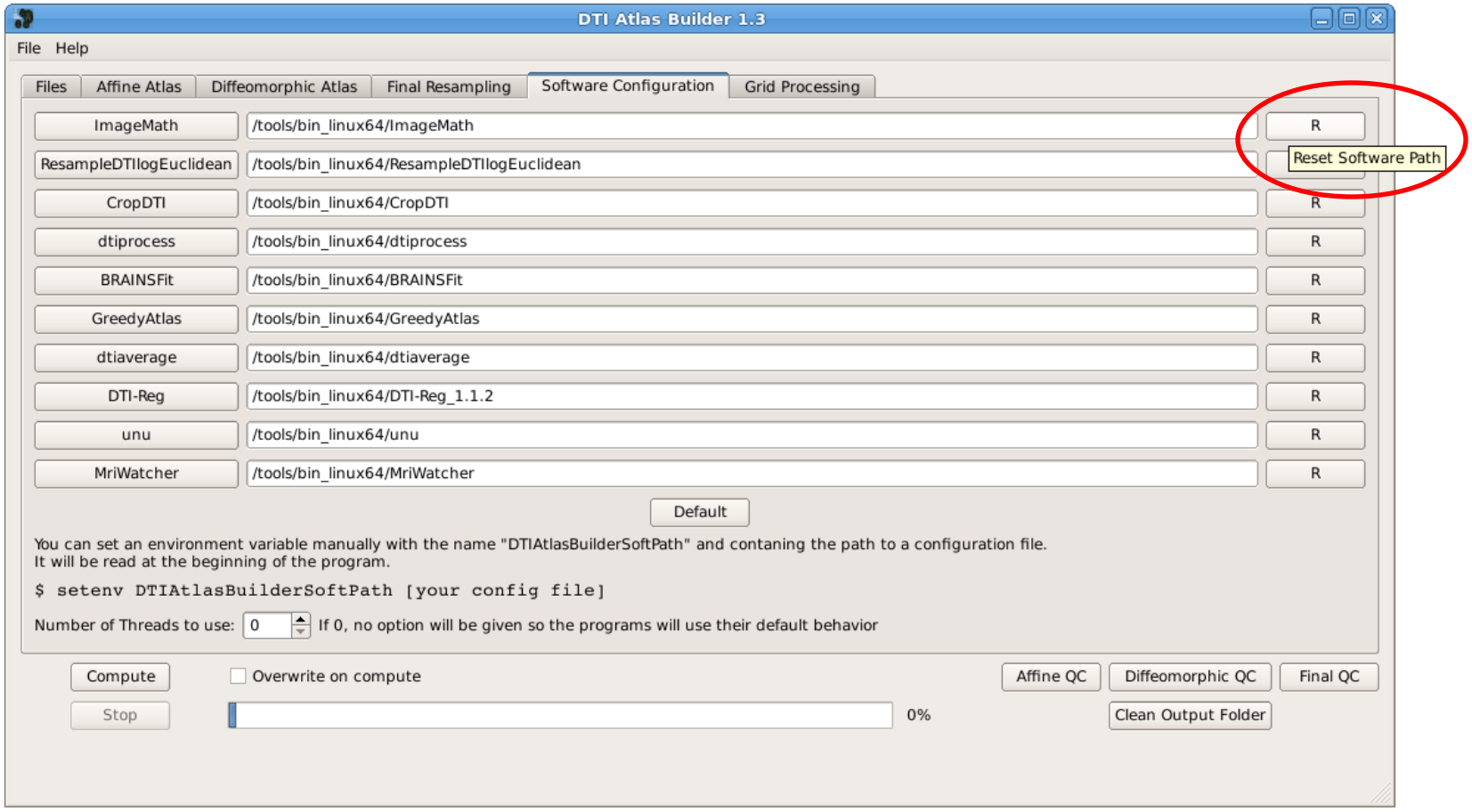
- By clicking the "Default" button, the program will automatically search all the programs in the PATH, and tell you if some of them are missing.

Automatic Configuration



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- 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.

- You can set an environment variable manually with the name "`DTIAtlasBuilderSoftPath`" and contaning the path to a configuration file. It will be read at the beginning of the program to configure the softwares.

- When opening the program, it will automatically search and load any file called "`DTIAtlasBuilderSoftConfig.txt`" in the directory where the executable is and in the current work directory.

  So you can put this file in any of these folders and you will not have to set an environment variable to have to software automatically configured.

Command Line Options

« `DTIAtlasBuilder --help` »:

- Load :
  - `-d <std::string>, --dataset_file <std::string>`:
    CSV file containing the dataset
  - `-p <std::string>, --parameter_file <std::string>` :
    Parameter file from this program
  - `-c <std::string>, --configuration_file <std::string>`:
    Software configuration file
- Options:
  - `--overwrite` : If you want to overwrite on compute (default: 0)
  - `--nogui` : If you do not need the GUI (default: 0)

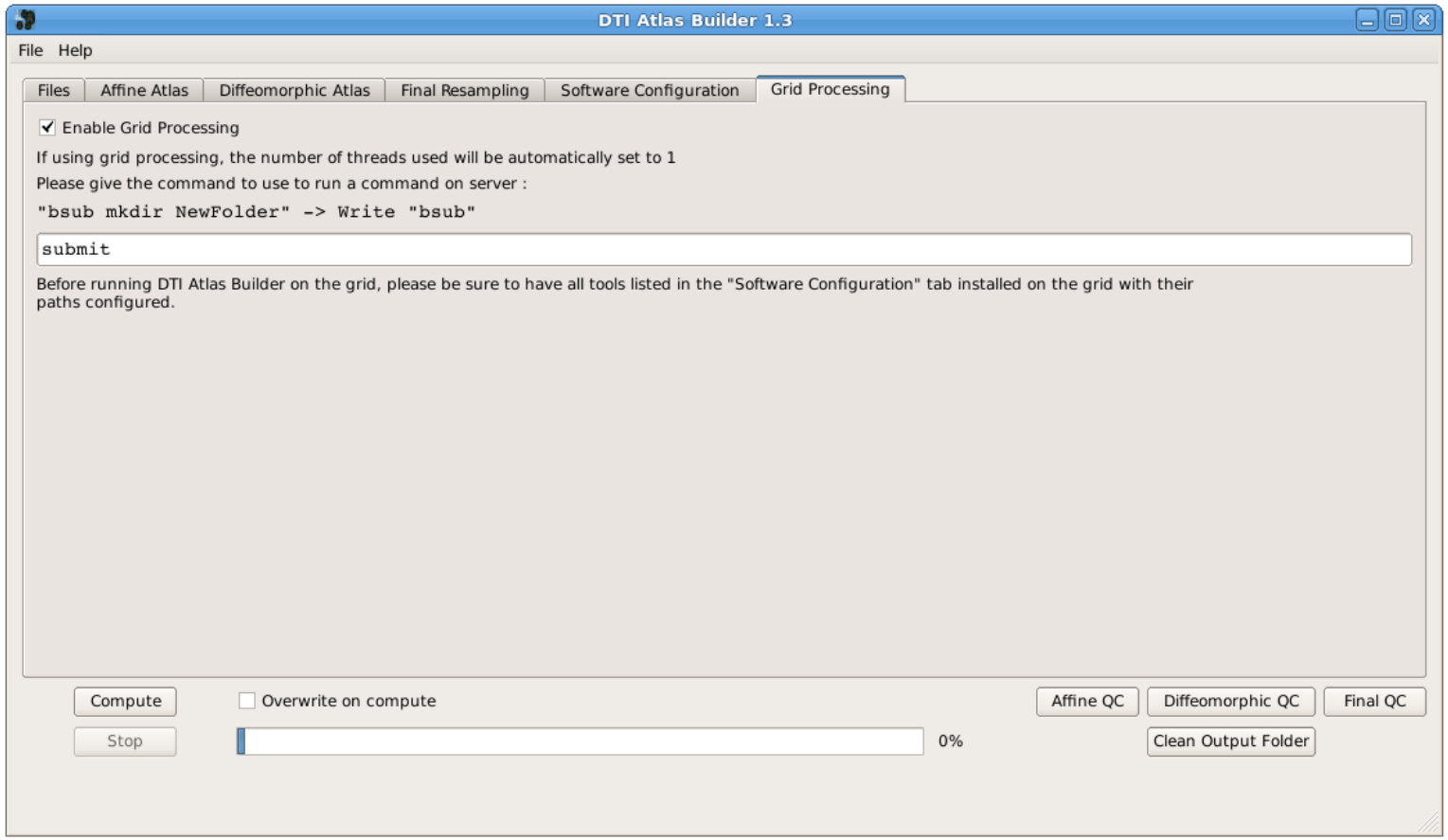
No GUI mode

- In « No GUI » mode, you need to set the parameters by giving a parameter file in command line :

```
DTIAtlasBuilder --nogui -p /home/DTIParameters.txt
```

- The program will not display the GUI and will run automatically with the given parameters, as if you had pushed the « Compute » button.

Grid Processing



- If you have the possibility of using a grid processing, you can run DTI Atlas Builder on this grid by checking the corresponding box and providing the submit command for your grid. For each step of the pipeline, the commands for all the cases will be submitted at the same time, and the program will wait until all cases have been processed.

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External Requirements

- As DTIAtlasBuilder uses some external tools that you may not have installed on your machine, you have the possibility to compile all tools you don't have in the same time than DTIAtlasBuilder
- The CMake cache contains an option « COMPILE_PACKAGE » that will allow you to choose which tool you want to recompile.

- The external programs needed are:

ImageMath	GreedyAtlas
ResampleDTIlogEuclidean	dtiaverage
CropDTI	DTI-Reg
dtiprocess	MriWatcher
BRAINSFit	unu

- You can also download the whole executable package, to have DTIAtlasBuilder and the other tools already compiled, ready to use:
  http://www.nitrc.org/projects/dtiatlasbuilder

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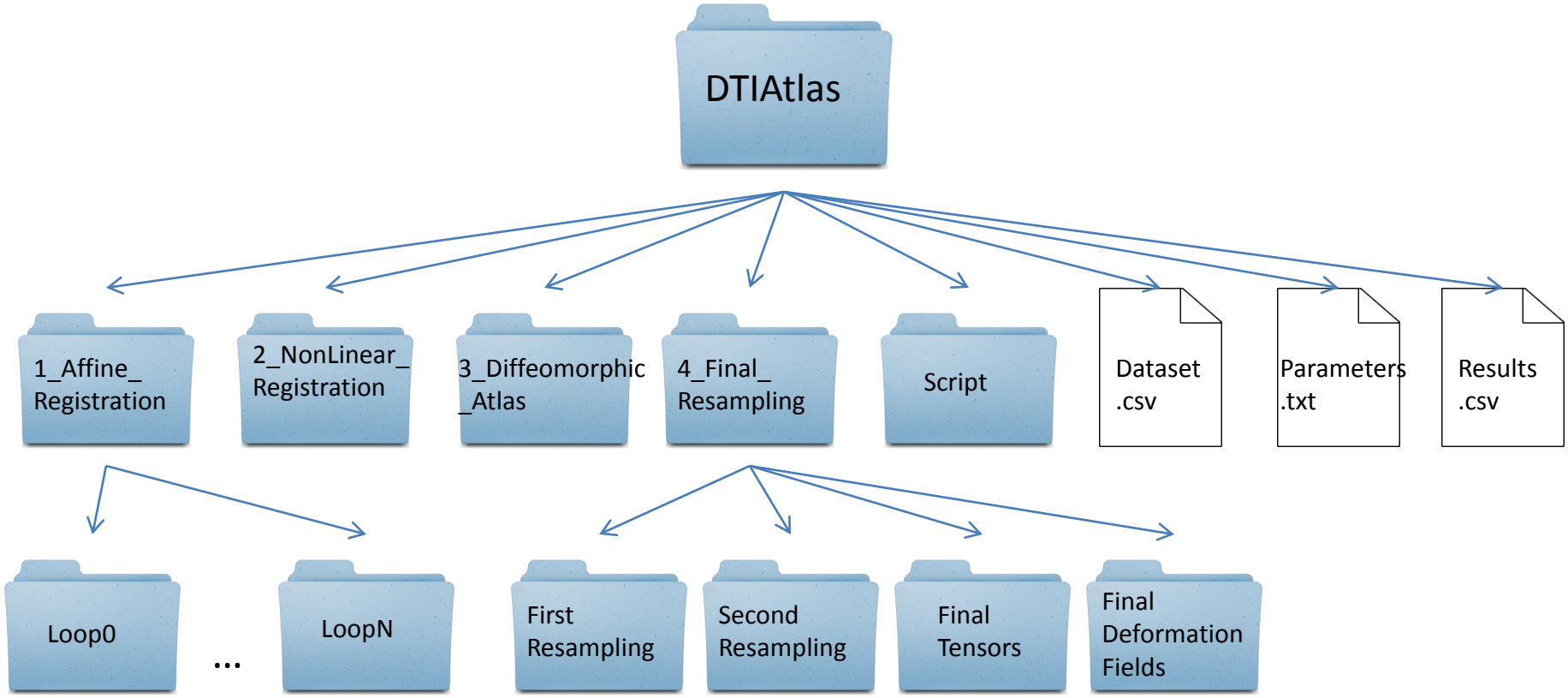
Data Organization



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Data Organization

- « 1_Affine_Registration » contains:
  - LoopN:
    - <case>_LoopN_FA.nrrd
    - <case>_LoopN_LinearTrans.txt
    - <case>_LoopN_LinearTrans_DTI.nrrd
    - <case>_LoopN_LinearTrans_FA.nrrd
    - <case>_LoopN_NormFA.nrrd
    - LoopN_FAAverage.nrrd
  - <case>_filteredDTI.nrrd
  - <case>_FA.nrrd
  - (<case>_croppedDTI.nrrd)
- « 2_NonLinear_Registration » contains:
  - GreedyAtlasParameters.xml
  - MeanImage.mhd
  - <case>_HField.mhd
  - <case>_InverseHField.mhd
  - <case>_NonLinearTrans_FA.mhd
- « 3_Diffeomorphic_Atlas » contains:
  - <case>_DiffeomorphicDTI.nrrd + float & FA
  - DiffeomorphicAtlasDTI.nrrd
    + float, FA, Color FA, MD, RD, AD
- « 4_Final_Resampling » contains:
  - Fisrt & Second_Resampling temp folders
  - **FinalTensors:**
    - **<case>_FinalDeformedDTI.nrrd + float & FA**
  - **FinalDeformationFields:**
    - **<case>_GlobalDisplacementField.nrrd**
  - FinalAtlasDTI.nrrd
    + float, FA, Color FA, MD, RD, AD
- « Script » contains:
  - DTIAtlasBuilder_MainScript.script
  - DTIAtlasBuilder_Preprocess.script
  - DTIAtlasBuilder_AtlasBuilding.script

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Troubleshooting

- Final Atlas is bad
  - If you see in the QC windows that the Affine and Diffeomorphic Atlases and registered images look OK, and that the Final Atlas and images look bad for all or most cases, that means that something went wrong during the FINAL registration.
    If this final registration was done using BRAINS, try to recompute it using ANTS (in the Final Resampling tab > Registration Method), which gives a better registration.
- Loading parameter file fail
  - If a parameter file fails to open in DTIAtlasBuilder (Parameter file is corrupted), you need to recreate it by loading only the corresponding dataset file and setting your options again.
- QC does not show up
  - If the QC windows do not appear when pushing the QC buttons, it might mean that you need to install the GLUT library to get MriWatcher to work.
    You can find the GLUT library here:
    http://www.opengl.org/resources/libraries/glut/glut_downloads.php

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Contact

For any remark or question, please email:

akaiser@unc.edu

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