**Latest released version:** v3.0.0-RC4

This neuroimaging processing pipeline software is developed by the Connectomics Lab at the University Hospital of Lausanne (CHUV) for use within the SNF Sinergia Project 170873, as well as for open-source software distribution. Source code is hosted on GitHub.

**Warning:** THIS SOFTWARE IS FOR RESEARCH PURPOSES ONLY AND SHALL NOT BE USED FOR ANY CLINICAL USE. THIS SOFTWARE HAS NOT BEEN REVIEWED OR APPROVED BY THE FOOD AND DRUG ADMINISTRATION OR EQUIVALENT AUTHORITY, AND IS FOR NON-CLINICAL, IRB-APPROVED RESEARCH USE ONLY. IN NO EVENT SHALL DATA OR IMAGES GENERATED THROUGH THE USE OF THE SOFTWARE BE USED IN THE PROVISION OF PATIENT CARE.
Connectome Mapper 3 implements full anatomical, diffusion and resting-state MRI processing pipelines, from raw Diffusion / T1 / T2 / BOLD data to multi-resolution connection matrices.

Connectome Mapper 3 pipelines use a combination of tools from well-known software packages, including FSL, FreeSurfer, ANTs, MRtrix3, Dipy and AFNI, empowered by the Nipype dataflow library. These pipelines were designed to provide the best software implementation for each state of processing, and will be updated as newer and better neuroimaging software become available.

This tool allows you to easily do the following:

- Handle T1 / Diffusion / resting-state MRI data, organized following the Brain Imaging Data Structure (BIDS) standard, from raw to multi-resolution connection matrices.
- Implement tools from different software packages.
• Achieve optimal data processing quality by using the best tools available
• Automate and parallelize processing steps, which provides a significant speed-up from typical linear, manual processing.

Portability, reproducibility and replicability are achieved through the distribution of a BIDSApp, a software container image which (1) takes datasets organized following the Brain Imaging Data Structure (BIDS) standard, and which (2) provides a frozen computing environment where versions of all external softwares and libraries are fixed.
CHAPTER TWO

LICENSE INFORMATION

This software is distributed under the open-source license Modified BSD. See license for more details.
All trademarks referenced herein are property of their respective holders.
AKNOWLEDGMENT

If your are using the Connectome Mapper 3 in your work, please acknowledge this software. See Citing for more details.

3.1 Help/Questions

If you run into any problems or have any questions, you can post to the CMTK-users group. Code bugs can be reported by creating a “New Issue” on the source code repository.
EAGER TO CONTRIBUTE?

Connectome Mapper 3 is open-source and all kind of contributions (bug reporting, documentation, code,...) are welcome! See *Contributing to Connectome Mapper* for more details.
5.1 Installation Instructions for Users

Warning: This software is for research purposes only and shall not be used for any clinical use. This software has not been reviewed or approved by the Food and Drug Administration or equivalent authority, and is for non-clinical, IRB-approved Research Use Only. In no event shall data or images generated through the use of the Software be used in the provision of patient care.

The Connectome Mapper 3 is composed of a Docker image, namely the Connectome Mapper 3 BIDS App, and a Python Graphical User Interface, namely the Connectome Mapper BIDS App Manager.

- Installation instructions for the Connectome mapper 3 BIDS App are found in Installation.
- Installation instructions for the Connectome mapper 3 BIDS App Manager are found in Installation.

Make sure that you have installed the following prerequisites.

5.1.1 The Connectome Mapper 3 BIDSAp

Prerequisites

- Install Docker Engine depending of your system:
  - For Ubuntu 14.04/16.04/18.04, follow the instructions at https://docs.docker.com/install/linux/docker-ce/ubuntu/
  - For Mac OSX (>=10.10.3), get the .dmg installer at https://store.docker.com/editions/community/docker-ce-desktop-mac
  - For Windows (>=10), get the installer at https://store.docker.com/editions/community/docker-ce-desktop-windows

Note: Connectome Mapper 3 BIDSAp has been tested only on Ubuntu and MacOSX. In principles, it should also run on Windows but it might require a few patches to make it work.

- Manage Docker as a non-root user
  - Open a terminal
  - Create the docker group:
Installation

Installation of the Connectome Mapper 3 has been facilitated through the distribution of a BIDSApp relying on the Docker software container technology.

- Open a terminal
- Get the latest release (v3.0.0-RC4) of the BIDS App:
  
  $ docker pull sebastientourbier/connectomemapper-bidsapp:v3.0.0-RC4

- To display all docker images available:

  $ docker images

You should see the docker image “connectomemapper-bidsapp” with tag “v3.0.0-RC4” is now available.

- You are ready to use the Connectome Mapper 3 BIDS App from the terminal. See its commandline usage.

## 5.1.2 The Connectome Mapper 3 BIDSApp Manager (GUI)

### Prerequisites

- Install miniconda3 (Python 3) from https://conda.io/miniconda.html

  Download the Python 3 installer corresponding to your 32/64bits MacOSX/Linux/Win system.

### Installation

The installation of the Connectome Mapper 3 BIDS App Manager (CMPBIDSAPPManager) consists of a clone of the source code repository, the creation of conda environment with all python dependencies installed, and eventually the installation of the CMPBIDSAPPManager itself, as follows:

- Open a terminal
- Go to the folder in which you would like to clone the source code repository:

  $ cd <INSTALLATION DIRECTORY>

- Clone the source code repository:

  $ git clone https://github.com/connectomicslab/connectomemapper3.git

  ...connectomemapper3

- Create a branch and checkout the code corresponding to this version release:
$ cd connectomemapper3
$ git fetch
$ git checkout tags/v3.0.0-RC4 -b v3.0.0-RC4

Note: If a few bugs related to the Graphical User Interface were fixed after releasing the version, you might want to use the code at its latest version on the master branch (i.e. git checkout master).

- Create a miniconda3 environment where all python dependencies will be installed:

  $ cd connectomemapper3
  $ conda env create -f environment.yml

Important: It seems there is no conda package for git-annex available on Mac. For your convenience, we created an additional environment_macosx.yml miniconda3 environment where the line - git-annex=XXXXXXX has been removed. Git-annex should be installed on MacOSX using brew i.e. brew install git-annex. See https://git-annex.branchable.com/install/ for more details.

Note that git-annex is only necessary if you wish to use BIDS datasets managed by Datalad (https://www.datalad.org/).

- Activate the conda environment:

  $ source activate py37cmp-gui

  or:

  $ conda activate py37cmp-gui

- Install the Connectome Mapper BIDS App Manager from the Bash Shell using pip:

  (py37cmp-gui)$ cd connectomemapper3/
  (py37cmp-gui)$ pip install .

- You are ready to use the Connectome Mapper 3 BIDS App Manager. See the dedicated user guide.

Help/Questions

If you run into any problems or have any questions, you can post to the CMTK-users group. Code bugs can be reported by creating a “New Issue” on the source code repository.

5.2 Connectome Mapper 3 and the BIDS standard

Connectome Mapper 3 (CMP3) adopts the BIDS (Brain Imaging Data Structure) standard for data organization and is developed following the BIDS App standard with a Graphical User Interface (GUI).

This means CMP3 can be executed in two different ways:

1. By running the BIDS App container image directly from the terminal or a script (See Commandline Usage section for more details).
2. By using its Graphical User Interface, designed to facilitate the configuration of all pipeline stages, the configuration of the BIDS App run and its execution, and the inspection of the different stage outputs with appropriate viewers (See Graphical User Interface section for more details).

5.2. Connectome Mapper 3 and the BIDS standard
For more information about BIDS and BIDS-Apps, please consult the BIDS Website, the Online BIDS Specifications, and the BIDSApps Website. HeuDiConv can assist you in converting DICOM brain imaging data to BIDS. A nice tutorial can be found @ BIDS Tutorial Series: HeuDiConv Walkthrough.

### 5.2.1 Example BIDS dataset

For instance, a BIDS dataset with T1w, DWI and rs-fMRI images should adopt the following organization, naming, and file formats:

```plaintext
ds-example/
  README
  CHANGES
  participants.tsv
  dataset_description.json

  sub-01/
    anat/
      sub-01_T1w.nii.gz
      sub-01_T1w.json
    dwi/
      sub-01_dwi.nii.gz
      sub-01_dwi.json
      sub-01_dwi.bvec
      sub-01_dwi.bval
    func/
      sub-01_task-rest_bold.nii.gz
      sub-01_task-rest_bold.json

  ...

  sub-<subject_label>/
    anat/
      sub-<subject_label>_T1w.nii.gz
      sub-<subject_label>_T1w.json

  ...
```

**Important:** Before using any BIDS App, we highly recommend you to validate your BIDS structured dataset with the free, online BIDS Validator.

### 5.3 Commandline Usage

Connectome Mapper 3 (CMP3) is distributed as a BIDS App which adopts the BIDS standard for data organization and takes as principal input the path of the dataset that is to be processed. The input dataset is required to be in valid BIDS format, and it must include at least a T1w or MPRAGE structural image and a DWI and/or resting-state fMRI image. See Connectome Mapper 3 and the BIDS standard page that provides links for more information about BIDS and BIDS-Apps as well as an example for dataset organization and naming.
**Warning:** As of CMP3 v3.0.0-RC2, the BIDS App includes a tracking system that anonymously reports the run of the BIDS App. This feature has been introduced to support us in the task of fund finding for the development of CMP3 in the future. However, users are still free to opt-out using the `--notrack` commandline argument.

**Important:** Since v3.0.0-RC4, configuration files adopt the JSON format. If you have your configuration files still in the old INI format, do not worry, the CMP3 BIDS App will convert them to the new JSON format automatically for you.

### 5.3.1 Commandline Arguments

The command to run CMP3 follows the BIDS-Apps definition standard with additional options for loading pipeline configuration files.

Entrypoint script of the BIDS-App Connectome Mapper version v3.0.0-RC4

```
usage: connectomemapper3 [-h]
                    [--participant_label PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]
                      ...
                      ]
                    [--session_label SESSION_LABEL [SESSION_LABEL ...]]
                    [--anat_pipeline_config ANAT_PIPELINE_CONFIG]
                    [--dwi_pipeline_config DWI_PIPELINE_CONFIG]
                    [--func_pipeline_config FUNC_PIPELINE_CONFIG]
                    [--number_of_threads NUMBER_OF_THREADS]
                    [--number_of_participants_processed_in_parallel NUMBER_OF_PARTICIPANTS_PROCESSED_IN_PARALLEL]
                    [--mrtix_random_seed MRTIX_RANDOM_SEED]
                    [--ants_random_seed ANTS_RANDOM_SEED]
                    [--ants_number_of_threads ANTS_NUMBER_OF_THREADS]
                    [--fs_license FS_LICENSE] [--coverage] [--notrack]
                    [-v]
                    bids_dir output_dir {participant,group}
```

**Positional Arguments**

- **bids_dir** The directory with the input dataset formatted according to the BIDS standard.
- **output_dir** The directory where the output files should be stored. If you are running group level analysis this folder should be prepopulated with the results of the participant level analysis.
- **analysis_level** Possible choices: participant, group  
  Level of the analysis that will be performed. Multiple participant level analyses can be run independently (in parallel) using the same output_dir.

### 5.3. Commandline Usage
Named Arguments

---participant_label The label(s) of the participant(s) that should be analyzed. The label corresponds to sub-<participant_label> from the BIDS spec (so it does not include “sub-”). If this parameter is not provided all subjects should be analyzed. Multiple participants can be specified with a space separated list.

---session_label The label(s) of the session that should be analyzed. The label corresponds to ses-<session_label> from the BIDS spec (so it does not include “ses-”). If this parameter is not provided all sessions should be analyzed. Multiple sessions can be specified with a space separated list.

---anat_pipeline_config Configuration .txt file for processing stages of the anatomical MRI processing pipeline

---dwi_pipeline_config Configuration .txt file for processing stages of the diffusion MRI processing pipeline

---func_pipeline_config Configuration .txt file for processing stages of the fMRI processing pipeline

---number_of_threads The number of OpenMP threads used for multi-threading by Freesurfer (Set to [Number of available CPUs -1] by default).

---number_of_participants_processed_in_parallel The number of subjects to be processed in parallel

Default: 1

---mrtrix_random_seed Fix MRtrix3 random number generator seed to the specified value

---ants_random_seed Fix ANTS random number generator seed to the specified value

---ants_number_of_threads Fix number of threads in ANTs. If not specified ANTs will use the same number as the number of OpenMP threads (see —number_of_threads option flag)

---fs_license Freesurfer license.txt

---coverage Run connectomemapper3 with coverage

Default: False

---notrack Do not send event to Google analytics to report BIDS App execution, which is enabled by default.

Default: False

-v, --version show program’s version number and exit

**Important:** Before using any BIDS App, we highly recommend you to validate your BIDS structured dataset with the free, online BIDS Validator.
5.3.2 Participant Level Analysis

To run the docker image in participant level mode (for one participant):

```bash
$ docker run -t --rm -u $(id -u):$(id -g) \
- v /home/localadmin/data/ds001:/bids_dir \
- v /media/localadmin/data/ds001/derivatives:/output_dir \
(-v /usr/local/freesurfer/license.txt:/bids_dir/code/license.txt \
 →)
sebastientourbier/connectomemapper-bidsapp:v3.0.0-RC4 \
/bids_dir /output_dir participant --participant_label 01 \
→|--session_label 01 \)
→|--anat_pipeline_config /bids_dir/code/ref_anatomical_config.json \
→|--dwi_pipeline_config /bids_dir/code/ref_diffusion_config.json \
→|--func_pipeline_config /bids_dir/code/ref_fMRI_config.json \
→|--number_of_participants_processed_in_parallel 1)
```

Note: The local directory of the input BIDS dataset (here: /home/localadmin/data/ds001) and the output directory (here: /media/localadmin/data/ds001/derivatives) used to process have to be mapped to the folders /bids_dir and /output_dir respectively using the -v docker run option.

Important: The user is requested to use its own Freesurfer license (available here). CMP expects by default to find a copy of the FreeSurfer license.txt in the code/ folder of the BIDS directory. However, one can also mount with the -v docker run option a freesurfer license.txt, which can be located anywhere on its computer (as in the example above, i.e. /usr/local/freesurfer/license.txt) to the code/ folder of the BIDS directory inside the docker container (i.e. /bids_dir/code/license.txt).

Note: At least a configuration file describing the processing stages of the anatomical pipeline should be provided. Diffusion and/or Functional MRI pipeline are performed only if a configuration file is set. The generation of such configuration files, the execution of the BIDS App docker image and output inspection are facilitated through the use of the Connectome Mapper GUI, i.e. cmpbidsappmanager (see dedicated documentation page)

5.3.3 Debugging

Logs are outputted into <output dir>/cmp/sub-<participant_label>/sub-<participant_label>_log-cmpbidsapp.txt.

5.3.4 Support, bugs and new feature requests

If you need any support or have any questions, you can post to the CMTK-users group.

All bugs, concerns and enhancement requests for this software are managed on GitHub and can be submitted at https://github.com/connectomicslab/connectomemapper3/issues.
5.3.5 Not running on a local machine?

If you intend to run CMP3 on a remote system such as a high-performance computing cluster where Docker is not available due to root privileges, a Singularity image is also built for your convenience and available on Sylabs.io. Please see instructions at Running on a cluster (HPC).

Also, you will need to make your data available within that system first. Comprehensive solutions such as Datalad will handle data transfers with the appropriate settings and commands. Datalad also performs version control over your data. A tutorial is provided in Adopting Datalad for collaboration.

5.4 Graphical User Interface

5.4.1 Introduction

Connectome Mapper 3 comes with a Graphical User Interface, the Connectome Mapper BIDS App manager, designed to facilitate the configuration of all pipeline stages, the configuration of the BIDS App run and its execution, and the inspection of the different stage outputs with appropriate viewers.

5.4.2 Start the Graphical User Interface

In a terminal, enter to following:

```
$ source activate py37cmp-gui
```

or:

```
$ conda activate py37cmp-gui
```

Please see Section Installation for more details about installation.

After activation of the conda environment, start the graphical user interface called Connectome Mapper 3 BIDS App Manager

```
$ cmpbidsappmanager
```

5.4.3 Load a BIDS dataset

The Connectome Mapper 3 BIDS App Manager allows you to:

- load a BIDS dataset stored locally.

You only have to select the root directory of your valid BIDS dataset (see note below)

- create a new datalad/BIDS dataset locally from an existing local or remote datalad/BIDS dataset (This is a feature under development)

Select the mode “Install a Datalad/BIDS dataset”.

If ssh connection is used, make sure to enable the “install via ssh” and to provide all connection details (IP address / Remote host name, remote user, remote password)

**Note:** The input dataset MUST be a valid BIDS structured dataset and must include at least one T1w or MPRAGE structural image. We highly recommend that you validate your dataset with the free, online BIDS Validator.
Fig. 1: Main window of the Connectome Mapper BIDS App Manager
5.4.4 Pipeline stage configuration

Start the Configurator Window

- From the main window, click on the left button to start the Configurator Window.

The window of the Connectome Mapper BIDS App Configurator will appear, which will assist you not only in configuring the pipeline stages (each pipeline has a tab panel), but also in creating appropriate configuration files which could be used outside the Graphical User Interface.

The outputs depend on the chosen parameters.
Fig. 2: Configurator Window of the Connectome Mapper
Anatomical pipeline stages

Fig. 3: Panel for configuration of anatomical pipeline stages
Segmentation

Performs tissue segmentation using Freesurfer.

Freesurfer

- **Number of threads**: used to specify how many threads are used for parallelization
- **Brain extraction tools**: alternative brain extraction methods injected in Freesurfer
- **Freesurfer args**: used to specify extra Freesurfer processing options

**Note**: If you have already Freesurfer output data available, CMP3 can use them if there are placed in your output / derivatives directory.

Parcellation

Generates the Native Freesurfer or Lausanne2008/Lausanne2018 parcellation from Freesurfer data.

**Parcellation scheme**

- **NativeFreesurfer**:
Atlas composed of 83 regions from the Freesurfer aparc+aseg file

- Lausanne2008:

Multi-resolution atlas

- Lausanne2018:
Lausanne 2008 atlas extended with 7 thalamic nuclei, 12 hippocampal subfields, and 4 brainstem sub-structure per hemisphere

Diffusion pipeline stages

Preprocessing

Preprocessing includes denoising, bias field correction, motion and eddy current correction for diffusion data.

Denoising
Fig. 4: Panel for configuration of diffusion pipeline stages
Remove noise from diffusion images using (1) MRtrix3 MP-PCA method or (2) Dipy Non-Local Mean (NLM) denoising with Gaussian or Rician noise models

**Bias field correction**

Remove intensity inhomogeneities due to the magnetic resonance bias field using (1) MRtrix3 N4 bias field correction or (2) the bias field correction provided by FSL FAST

**Motion correction**

Aligns diffusion volumes to the b0 volume using FSL’s MCFLIRT

**Eddy current correction**

Corrects for eddy current distortions using FSL’s Eddy correct tool

**Resampling**

Resample morphological and diffusion data to F0 x F1 x F2 mm^3

**Registration**

**Registration mode**

- FSL (Linear):
Perform linear registration from T1 to diffusion b0 using FSL’s flirt

- Non-linear (ANTS):
Perform symmetric diffeomorphic SyN registration from T1 to diffusion b=0

**Diffusion reconstruction and tractography**

Perform diffusion reconstruction and local deterministic or probabilistic tractography based on several tools. ROI dilation is required to map brain connections when the tracking only operates in the white matter.

**Reconstruction tool**

**Dipy**: perform SHORE, tensor, CSD and MAP-MRI reconstruction

- SHORE:
Fig. 5: Diffusion stage configuration window
SHORE performed only on DSI data

- Tensor:

  Tensor performed only on DTI data

- CSD:

  CSD performed on DTI and multi-shell data

- MAP_MRI:
MAP-MRI performed only on multi-shell data

**MRtrix**: perform CSD reconstruction.

- **CSD**: CSD performed on DTI and multi-shell data

**Tractography tool**

**Dipy**: perform deterministic and probabilistic fiber tracking as well as particle filtering tractography.

- Deterministic tractography:
Deterministic tractography (SD_STREAM) performed on single tensor or CSD reconstruction

- Probabilistic tractography:

Probabilistic tractography (iFOD2) performed on SHORE or CSD reconstruction

- Probabilistic particle filtering tractography (PFT):
Probabilistic PFT tracking performed on SHORE or CSD reconstruction. Seeding from the gray matter / white matter interface is possible.

**Note:** We noticed a shift of the center of tractograms obtained by dipy. As a result, tractograms visualized in TrackVis are not commonly centered despite the fact that the tractogram and the ROIs are properly aligned.

**MRtrix:** perform deterministic and probabilistic fiber tracking as well as anatomically-constrained tractography. ROI dilation is required to map brain connections when the tracking only operates in the white matter.

- Deterministic tractography:
Deterministic tractography (SD_STREAM) performed on single tensor or CSD reconstruction

- Deterministic anatomically-constrained tractography (ACT):
Deterministic ACT tracking performed on single tensor or CSD reconstruction. Seeding from the gray matter / white matter interface is possible. Backtrack option is not available in deterministic tracking.

- Probabilistic tractography:
Probabilistic tractography (iFOD2) performed on SHORE or CSD reconstruction

• Probabilistic anatomically-constrained tractography (ACT):

![Graphical User Interface](image.png)
Probabilistic ACT tracking performed on SHORE or CSD reconstruction. Seeding from the gray matter / white matter interface is possible.

Connectome

Compute fiber length connectivity matrices. If DTI data is processed, FA additional map is computed. In case of DSI, additional maps include GFA and RTOP. In case of MAP-MRI, additional maps are RTPP, RTOP, . . .
Output types

Select in which formats the connectivity matrices should be saved.

FMRI pipeline stages

Preprocessing

Preprocessing refers to processing steps prior to registration. It includes discarding volumes, despiking, slice timing correction and motion correction for fMRI (BOLD) data.

Discard n volumes

Discard n volumes from further analysis

Despiking

5.4. Graphical User Interface
Fig. 6: Panel for configuration of fMRI pipeline stages
Perform despiking of the BOLD signal using AFNI.

*Slice timing and Repetition time*

Perform slice timing correction using FSL’s slicetimer.

*Motion correction*

Align BOLD volumes to the mean BOLD volume using FSL’s MCFLIRT.

**Registration**

**Registration mode**

- FSL (Linear):

![Registration_mode](image)

Perform linear registration from T1 to mean BOLD using FSL’s flirt.

- BBRegister (FS)
Perform linear registration using Freesurfer BBregister tool from T1 to mean BOLD via T2.

**Warning:** development in progress

**fMRI processing**

Performs detrending, nuisance regression, bandpass filtering, diffusion reconstruction and local deterministic or probabilistic tractography based on several tools. ROI dilation is required to map brain connections when the tracking only operates in the white matter.

*Detrending*
Detrending of BOLD signal using:

1. *linear* trend removal algorithm provided by the *scipy* library
2. *quadratic* trend removal algorithm provided by the *obspy* library

*Nuisance regression*
A number of options for removing nuisance signals is provided. They consist of:

1. *Global signal* regression
2. *CSF* regression
3. *WM* regression
4. *Motion parameters* regression

*Bandpass filtering*
Perform bandpass filtering of the time-series using FSL’s slicetimer

**Connectome**

Computes ROI-averaged time-series and the correlation connectivity matrices.
Output types

Select in which formats the connectivity matrices should be saved.

Save the configuration files

You can save the pipeline stage configuration files in two different ways:

1. You can save all configuration files at once by clicking on the Save All Pipeline Configuration Files. This will save automatically the configuration file of the anatomical / diffusion / fMRI pipeline to `<bids_dataset>/code/ref_anatomical_config.ini` / `<bids_dataset>/code/ref_diffusion_config.ini` / `<bids_dataset>/code/ref_fMRI_config.ini` respectively.

2. You can save individually each of the pipeline configuration files and edit its filename in the File menu (File -> Save anatomical/diffusion/fMRI configuration file as...)

Nipype

Connectome Mapper relies on Nipype. All intermediate steps for the processing are saved in the corresponding `<bids_dataset/derivatives>/nipype/sub-<participant_label>/<pipeline_name>/<stage_name>` stage folder (See Nipype workflow outputs for more details).

5.4.5 Run the BIDS App

Start the Connectome Mapper BIDS App GUI

- From the main window, click on the middle button to start the Connectome Mapper BIDS App GUI.
The window of the Connectome Mapper BIDS App GUI will appear, which will help you in setting up and launching the BIDS App run.

**Run configuration**

- Select the output directory for data derivatives
**Fig. 7:** Window of the Connectome Mapper BIDS App GUI
5.4. Graphical User Interface

- Select the subject labels to be processed
• Tune the number of subjects to be processed in parallel

![Image]

• Tune the advanced execution settings for each subject process. This include finer control on the number of threads used by each process as well as on the seed value of ANTs and MRtrix random number generators.
**Important:** Make sure the number of threads multiplied by the number of subjects being processed in parallel do not exceed the number of CPUs available on your system.

- Check/Uncheck the pipelines to be performed
Note: The list of pipelines might vary as it is automatically updated based on the availability of diffusion MRI and resting-state fMRI data.

- Specify your Freesurfer license
**Note:** Your Freesurfer license will be copied to your dataset directory as `<bids_dataset>/code/license.txt` which will be mounted inside the BIDS App container image.

- When the run is set up, you can click on the **Check settings** button.
• If the setup is complete and valid, this will enable the Run BIDS App button.
You are ready to launch the BIDS App run!

**Launch the BIDS App run**

- Click on the **Run BIDS App** button to launch the BIDS App run

You can see the complete `docker run` command generated by the Connectome Mapper BIDS App GUI from the terminal output such as in this example:

```
Start BIDS App
> FreeSurfer license copy skipped as it already exists (BIDS App Manager)
> Datalad available: True
```
> BIDS dataset: /bids_dir
> Subjects to analyze: ['103818']
> Set $FS_LICENSE which points to FreeSurfer license location (BIDS App)
> ... $FS_LICENSE : /bids_dir/code/license.txt
> * Number of subjects to be processed in parallel set to 1 (Total of...
>   → cores available: 11)
> * Number of parallel threads set to 10 (total of cores: 11)
> * OMP_NUM_THREADS set to 10 (total of cores: 11)
> * ITK_GLOBAL_DEFAULT_NUMBER_OF_THREADS set to 10
> Report execution to Google Analytics.
> Thanks to support us in the task of finding new funds for CMP3...
>   development!
> Sessions to analyze: ['ses-01']
> Process subject sub-103818 session ses-01
> WARNING: rewriting config file /output_dir/cmp/sub-103818/ses-01/sub-
>   →103818_ses-01_anatomical_config.ini
>   ... Anatomical config created : /output_dir/cmp/sub-103818/ses-01/sub-
>   →103818_ses-01_anatomical_config.ini
> WARNING: rewriting config file /output_dir/cmp/sub-103818/ses-01/sub-
>   →103818_ses-01_diffusion_config.ini
>   ... Diffusion config created : /output_dir/cmp/sub-103818/ses-01/sub-
>   →103818_ses-01_diffusion_config.ini
> WARNING: rewriting config file /output_dir/cmp/sub-103818/ses-01/sub-
>   →103818_ses-01_fMRI_config.ini
>   ... fMRI config created : /output_dir/cmp/sub-103818/ses-01/sub-103818_...
>   →ses-01_fMRI_config.ini
> Running pipelines:
>   - Anatomical MRI (segmentation and parcellation)
>   - Diffusion MRI (structural connectivity matrices)
>   - fMRI (functional connectivity matrices)
> ... cmd : connectomemapper3 --bids_dir /bids_dir --output_dir /output_dir...
>   --participant_label sub-103818 --session_label ses-01 --anat_pipeline_...
>   --dwi_pipeline_config /output_dir/cmp/sub-103818/ses-01/sub-103818_ses-01...
>   --func_pipeline_config /output_dir/cmp/sub-103818/ses-01/sub-103818_ses-01
>   →threads 10

Note: Also, this can be helpful in you wish to design your own batch scripts to call the BIDS App with the correct syntax.
Check progress

For each subject, the execution output of the pipelines are redirected to a log file, written as <bids_dataset/derivatives>/cmp/sub-<subject_label>_log.txt. Execution progress can be checked by the means of these log files.

5.4.6 Check stages outputs

Start the Inspector Window

- From the main window, click on the right button to start the Inspector Window.

- The window of the Connectome Mapper BIDS App Inspector will appear, which will assist you in inspecting outputs of the different pipeline stages (each pipeline has a tab panel).
Anatomical pipeline stages

• Click on the stage you wish to check the output(s):

Fig. 8: Panel for configuration of anatomical pipeline stages
Segmentation

- Select the desired output from the list and click on view:

![Inspect stage window](image)

Segmentation results

Surfaces extracted using Freesurfer.

![Segmentation result](image)

T1 segmented using Freesurfer.
Parcellation

- Select the desired output from the list and click on view:
Parcellation results

Cortical and subcortical parcellation are shown with Freeview.
Diffusion pipeline stages

- Click on the stage you wish to check the output(s):

Fig. 9: Panel for configuration of diffusion pipeline stages
Preprocessing

- Select the desired output from the list and click on view:

Registration

- Select the desired output from the list and click on view:

Registration results

Registration of T1 to Diffusion space (b0). T1 in copper overlayed to the b0 image.
Diffusion reconstruction and tractography

- Select the desired output from the list and click on view:

Tractography results

DSI Tractography results are displayed with TrackVis.
Connectome

- Select the desired output from the list and click on view:

Generated connection matrix
Displayed using a:

1. matrix layout with pyplot
2. circular layout with pyplot and MNE
FMRI pipeline stages

- Click on the stage you wish to check the output(s):
Fig. 10: Panel for configuration of fMRI pipeline stages

5.4. Graphical User Interface
Preprocessing

- Select the desired output from the list and click on view:

Registration

- Select the desired output from the list and click on view:
fMRI processing

- Select the desired output from the list and click on view:

ROI averaged time-series
Connectome

- Select the desired output from the list and click on view:

Generated connection matrix

Displayed using a:

1. matrix layout with pyplot
2. circular layout with pyplot and MNE
5.5 Outputs of Connectome Mapper 3

Processed, or derivative, data are outputed to `<bids_dataset/derivatives>/`. 

5.5.1 BIDS derivatives entities

<table>
<thead>
<tr>
<th>Entity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sub-&lt;label&gt;</td>
<td>Distinguish different subjects</td>
</tr>
<tr>
<td>ses-&lt;label&gt;</td>
<td>Distinguish different acquisition sessions</td>
</tr>
<tr>
<td>label-&lt;label&gt;</td>
<td>Describe the type of brain tissue segmented (for _probsseg/dseg)</td>
</tr>
<tr>
<td>atlas-&lt;label&gt;</td>
<td>Distinguish data derived from different types of parcellation atlases</td>
</tr>
<tr>
<td>res-&lt;label&gt;</td>
<td>Distinguish data derived from the different scales of Lausanne2008 and Lausanne2018 parcellation atlases</td>
</tr>
<tr>
<td>space-DWI</td>
<td>Distinguish anatomical MRI derivatives in the target diffusion MRI space</td>
</tr>
<tr>
<td>model-&lt;label&gt;</td>
<td>Distinguish different diffusion signal models (DTI, CSD, SHORE, MAPMRI)</td>
</tr>
</tbody>
</table>

See Original BIDS Entities Appendix for more description.

Note: Connectome Mapper 3 introduced a new BIDS entity `atlas-<atlas_label>` (where `<atlas_label>`: Desikan/L2008/L2018), that is used in combination with the `res-<atlas_scale>` (where `<atlas_scale>`: scale1/scale2/scale3/scale4/scale5) entity to distinguish data derived from different parcellation atlases and different scales.

5.5.2 Main Connectome Mapper Derivatives

Main outputs produced by Connectome Mapper 3 are written to `cmp/sub-<subject_label>/`. In this folder, a configuration file generated for each modality pipeline (i.e. anatomical/diffusion/fMRI) and used for processing each participant is saved as `sub-<subject_label>_anatomical/diffusion/fMRI_config.ini`. It summarizes pipeline workflow options and parameters used for processing. An execution log of the full workflow is saved as `sub-<subject_label>_log.txt`.

Anatomical derivatives

- Anatomical derivatives in the individual T1w space are placed in each subject’s `anat/` subfolder, including:
  - The original T1w image:
    - `anat/sub-<subject_label>_desc-head_T1w.nii.gz`
  - The masked T1w image with its corresponding brain mask:
    - `anat/sub-<subject_label>_desc-brain_T1w.nii.gz`
    - `anat/sub-<subject_label>_desc-brain_mask.nii.gz`
  - The segmentations of the white matter (WM), gray matter (GM), and Cortical Spinal Fluid (CSF) tissues:
    - `anat/sub-<subject_label>_label-WM_dseg.nii.gz`
The five different brain parcellations:

* anat/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>]_dseg.nii.gz

where:

- <atlas_label>: Desikan/L2008/L2018 is the parcellation scheme used
- <scale_label>: scale1, scale2, scale3, scale4, scale5 corresponds to the parcellation scale if applicable

with the description of parcel labels and the updated FreeSurfer color lookup table:

* anat/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>]_dseg.graphml

* anat/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>]_FreeSurferColorLUT.txt

Anatomical derivatives in the DWI space produced by the diffusion pipeline are placed in each subject’s anat/subfolder, including:

- The unmasked T1w image:
  * anat/sub-<subject_label>_space-DWI_desc-head_T1w.nii.gz

- The masked T1w image with its corresponding brain mask:
  * anat/sub-<subject_label>_space-DWI_desc-brain_T1w.nii.gz
  * anat/sub-<subject_label>_space-DWI_desc-brain_mask.nii.gz

- The segmentation of WM tissue used for tractography seeding:
  * anat/sub-<subject_label>_space-DWI_label-WM_dseg.nii.gz

- The five different brain parcellation are saved as:
  * anat/sub-<subject_label>_space-DWI_atlas-<atlas_label>[_res-<scale_label>]_dseg.nii.gz

where:

- <atlas_label>: Desikan/L2008/L2018 is the parcellation scheme used
- <scale_label>: scale1, scale2, scale3, scale4, scale5 corresponds to the parcellation scale if applicable

- The 5TT image used for Anatomically Constrained Tractography (ACT):
  * anat/sub-<subject_label>_space-DWI_label-5TT_probseg.nii.gz

- The partial volume maps for white matter (WM), gray matter (GM), and Cortical Spinal Fluid (CSF) used for Particle Filtering Tractography (PFT), generated from 5TT image:
  * anat/sub-<subject_label>_space-DWI_label-WM_probseg.nii.gz
  * anat/sub-<subject_label>_space-DWI_label-GM_probseg.nii.gz
  * anat/sub-<subject_label>_space-DWI_label-CSF_probseg.nii.gz

- The GM/WM interface used for ACT and PFT seeding:
  * anat/sub-<subject_label>_space-DWI_label-GMWMI_probseg.nii.gz
Diffusion derivatives

Diffusion derivatives in the individual DWI space are placed in each subject’s dwi/ subfolder, including:

- The final preprocessed DWI image used to fit the diffusion model for tensor or fiber orientation distribution estimation:
  - dwi/sub-<subject_label>_desc-preproc_dwi.nii.gz

- The brain mask used to mask the DWI image:
  - dwi/sub-<subject_label>_desc-brain_mask_resampled.nii.gz

- The diffusion tensor (DTI) fit (if used for tractography):
  - dwi/sub-<subject_label>_desc-WLS_model-DTI_diffmodel.nii.gz
    with derived Fractional Anisotropic (FA) and Mean Diffusivity (MD) maps:
    - dwi/sub-<subject_label>_model-DTI_FA.nii.gz
    - dwi/sub-<subject_label>_model-DTI_MD.nii.gz

- The Fiber Orientation Distribution (FOD) image from Constrained Spherical Deconvolution (CSD) fit (if performed):
  - dwi/sub-<subject_label>_model-CSD_diffmodel.nii.gz

- The MAP-MRI fit for DSI and multi-shell DWI data (if performed):
  - dwi/sub-<subject_label>_model-MAPMRI_diffmodel.nii.gz
    with derived Generalized Fractional Anisotropic (GFA), Mean Squared Displacement (MSD), Return-to-Origin Probability (RTOP) and Return-to-Plane Probability (RTPP) maps:
    - dwi/sub-<subject_label>_model-MAPMRI_GFA.nii.gz
    - dwi/sub-<subject_label>_model-MAPMRI_MSD.nii.gz
    - dwi/sub-<subject_label>_model-MAPMRI_RTOP.nii.gz
    - dwi/sub-<subject_label>_model-MAPMRI_RTPP.nii.gz

- The SHORE fit for DSI data:
  - dwi/sub-<subject_label>_model-SHORE_diffmodel.nii.gz
    with derived Generalized Fractional Anisotropic (GFA), Mean Squared Displacement (MSD), Return-to-Origin Probability (RTOP) maps:
    - dwi/sub-<subject_label>_model-SHORE_GFA.nii.gz
    - dwi/sub-<subject_label>_model-SHORE_MSD.nii.gz
    - dwi/sub-<subject_label>_model-SHORE_RTOP.nii.gz

- The tractogram:
  - dwi/sub-<subject_label>_model-<model_label>_desc-<label>_tractogram.trk
    where:
    * <model_label> is the diffusion model used to drive tractography (DTI, CSD, SHORE)
    * <label> is the type of tractography algorithm employed (DET for deterministic, PROB for probabilistic)

- The structural connectivity (SC) graphs:

5.5. Outputs of Connectome Mapper 3
Functionally derived data

Functionally derived data in the ‘meanBOLD’ (individual) space are placed in each subject’s func/ subfolder including:

- The original BOLD image:
  - func/sub-<subject_label>_task-rest_desc-cmp_bold.nii.gz
- The mean BOLD image:
  - func/sub-<subject_label>_meanBOLD.nii.gz
- The fully preprocessed band-pass filtered used to compute ROI time-series:
  - func/sub-<subject_label>_desc-bandpass_task-rest_bold.nii.gz
- For scrubbing (if enabled):
  - The change of variance (DVARS):
    - func/sub-<subject_label>_desc-scrubbing_DVARS.npy
  - The frame displacement (FD):
    - func/sub-<subject_label>_desc-scrubbing_FD.npy
- Motion-related time-series:
  - func/sub-<subject_label>_motion.tsv
- The ROI time-series for each parcellation scale:
  - func/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>_timeseries.npy
  - func/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>_timeseries.mat
  where:
  * <atlas_label>: Desikan/L2008/L2018 is the parcellation scheme used
  * <scale_label>: scale1, scale2, scale3, scale4, scale5 corresponds to the parcellation scale if applicable

- The functional connectivity (FC) graphs:
  - func/sub-<subject_label>_atlas-<atlas_label>[_res-<scale_label>])_conndata-network_connectivity.<fmt>
  where:
  * <atlas_label>: Desikan/L2008/L2018 is the parcellation scheme used
* `<scale_label>`: scale1, scale2, scale3, scale4, scale5 corresponds to the parcellation scale if applicable
* `<fmt>`: mat/gpickle/tsv/graphml is the format used to store the graph

5.5.3 FreeSurfer Derivatives

A FreeSurfer subjects directory is created in `<bids_dataset/derivatives>/freesurfer`.

```
freesurfer/
  fsaverage/
  mri/
  surf/
  ...
  sub-<subject_label>/
  mri/
  surf/
  ...
  ...
```

The fsaverage subject distributed with the running version of FreeSurfer is copied into this directory.

5.5.4 Nipype Workflow Derivatives

The execution of each Nipype workflow (pipeline) dedicated to the processing of one modality (i.e. anatomical/diffusion/fMRI) involves the creation of a number of intermediate outputs which are written to `<bids_dataset/derivatives>/nipype/sub-<subject_label>/<anatomical/diffusion/fMRI>_pipeline` respectively:

To enhance transparency on how data is processed, outputs include a pipeline execution graph saved as `<anatomical/diffusion/fMRI>_pipeline/graph.svg` which summarizes all processing nodes involves in the given processing pipeline:
Execution details (data provenance) of each interface (node) of a given pipeline are reported in `<anatomical/diffusion/fMRI>_pipeline/<stage_name>/<interface_name>_report/report.rst`

Node: segmentation_stage (reconall (freesurfer))

Hierarchy: anatomical_pipeline.segmentation_stage.reconall

Exec ID: reconall

Original Inputs

* FLAIR_file: <undefined>
* T1_files: <undefined>
* T2_file: <undefined>
* args:
  * big_ventricles: <undefined>
  * brainstem: <undefined>
  * directive: all
  * environ: {}
* expert: <undefined>
* flags: [u'-no-isrunning']
* hemi: <undefined>
* hippocampal_subfields_T1: <undefined>
* hippocampal_subfields_T2: <undefined>
* hires: <undefined>
* mprage: <undefined>
* mri_aparc2aseg: <undefined>
* mri_ca_label: <undefined>
* mri_ca_normalize: <undefined>
* mri_ca_register: <undefined>
* mri_edit_wm_with_aseg: <undefined>
* mri_em_register: <undefined>

Note: Connectome Mapper 3 outputs are currently being updated to conform to BIDS v1.4.0.

### 5.6 Packages and modules

#### 5.6.1 cmp package

Submodules

**cmp.parser module**

Connectome Mapper 3 Commandline Parser.

```python
cmp.parser.get()
```

Return the argparse parser of the BIDS App.

- **Returns**: `p` – Instance of `argparse.ArgumentParser` class
- **Return type**: `object`
**cmp.project module**

Definition of classes and functions for handling non-GUI general events.

```python
class cmp.project.CMP_Project_Info
    Bases: traits.has_traits.HasTraits

    Class used to store all properties of a processing project.

    **base_directory**
    BIDS dataset root directory
    Type: traits.Directory

    **output_directory**
    Output directory
    Type: traits.Directory

    **bids_layout**
    Instance of pybids BIDSLayout
    Type: bids.BIDSLayout

    **subjects**
    List of subjects in the dataset
    Type: traits.List

    **subject**
    Subject being processed in the form sub-XX

    **subject_sessions**
    List of sessions for the subject being processed
    Type: traits.List

    **subject_session**
    Session of the subject being processed in the form ses-YY
    Type: traits.Str

    **diffusion_imaging_model**
    Diffusion imaging model that can be ‘DSI’, ‘DTI’, ‘HARDI’ or ‘multishell’
    Type: traits.Str

    **dmri_bids_acqs**
    List diffusion imaging models extracted from acq-<label> filename part.
    Type: traits.List

    **dmri_bids_acq**
    Diffusion imaging model being processed

    **anat_runs**
    List of run labels for T1w scans with multiple runs
    Type: traits.List

    **anat_run**
    Run being processed for T1w scans with multiple runs
    Type: traits.Str
```
**dmri_runs**
List of run labels for DWI scans with multiple runs
Type traits.List

**dmri_run**
Run being processed for DWI scans with multiple runs
Type traits.Str

**fmri_runs**
List of run labels for fMRI scans with multiple runs
Type traits.List

**fmri_run**
Run being processed for fMRI scans with multiple runs
Type traits.Str

**parcellation_scheme**
Parcellation scheme used (Default: ‘Lausanne2008’)
Type traits.Str

**atlas_info**
Dictionary storing parcellation atlas information See ParcellationStage for more details
Type traits.Dict

**freesurfer_subjects_dir**
Freesurfer subjects directory
Type traits.Str

**freesurfer_subject_id**
Freesurfer subject ID
Type traits.Str

**t1_available**
True if T1w scans were found (Default: False)
Type Bool

**dmri_available**
True if DWI scans were found (Default: False)
Type Bool

**fmri_available**
True if fMRI scans were found (Default: False)
Type Bool

**anat_config_error_msg**
Error message for the anatomical pipeline configuration file
Type traits.Str

**anat_config_to_load**
Path to a configuration file for the anatomical pipeline
Type traits.Str

**anat_available_config**
List of configuration files for the anatomical pipeline
**Type**  traits.List

**anat_stage_names**
List of anatomical pipeline stage names

**Type**  traits.List

**anat_custom_last_stage**
Custom last anatomical pipeline stage to be processed

**Type**  traits.Str

**dmri_config_error_msg**
Error message for the diffusion pipeline configuration file

**Type**  traits.Str

**dmri_config_to_load**
Path to a configuration file for the diffusion pipeline

**Type**  traits.Str

**dmri_available_config**
List of configuration files for the anatomical pipeline

**Type**  traits.List

**dmri_stage_names**
List of diffusion pipeline stage names

**Type**  traits.List

**dmri_custom_last_stage**
Custom last diffusion pipeline stage to be processed

**Type**  traits.Str

**fmri_config_error_msg**
Error message for the fMRI pipeline configuration file

**Type**  traits.Str

**fmri_config_to_load**
Path to a configuration file for the fMRI pipeline

**Type**  traits.Str

**fmri_available_config**
List of configuration files for the fMRI pipeline

**Type**  traits.List

**fmri_stage_names**
List of fMRI pipeline stage names

**Type**  traits.List

**fmri_custom_last_stage**
Custom last fMRI pipeline stage to be processed

**Type**  traits.Str

**number_of_cores**
Number of cores used by Nipype workflow execution engine to distribute independent processing nodes
(Must be in the range of your local resources)

**Type**  int
cmp.project.init_anat_project(project_info, is_new_project, debug=False)
Initialize the anatomical processing pipeline.

Parameters

- project_info (cmp.project.CMP_Project_Info) – Instance of cmp.project.CMP_Project_Info object
- is_new_project (bool) – Specify if it corresponds or not to a new project. If True, it will create initial pipeline configuration files.
- debug (bool) – If True, display extra prints to support debugging

Returns anat_pipeline – AnatomicalPipeline object instance
Return type Instance(cmp.pipelines.anatomical.anatomical.AnatomicalPipeline)

cmp.project.init_dmri_project(project_info, bids_layout, is_new_project, gui=True, debug=False)
Initialize the diffusion processing pipeline.

Parameters

- project_info (cmp.project.CMP_Project_Info) – Instance of cmp.project.CMP_Project_Info object
- bids_layout (bids.BIDSLayout) – Instance of BIDSLayout object
- is_new_project (bool) – Specify if it corresponds or not to a new project. If True, it will create initial pipeline configuration files.
- gui (bool) – Might be obsolete and removed in future versions
- debug (bool) – If True, display extra prints to support debugging

Returns dmri_pipeline – DiffusionPipeline object instance
Return type Instance(cmp.pipelines.diffusion.diffusion.DiffusionPipeline)

cmp.project.init_fmri_project(project_info, bids_layout, is_new_project, gui=True, debug=False)
Initialize the fMRI processing pipeline.

Parameters

- project_info (cmp.project.CMP_Project_Info) – Instance of cmp.project.CMP_Project_Info object
- bids_layout (bids.BIDSLayout) – Instance of BIDSLayout object
- is_new_project (bool) – Specify if it corresponds or not to a new project. If True, it will create initial pipeline configuration files.
- gui (bool) – Might be obsolete and removed in future versions
- debug (bool) – If True, display extra prints to support debugging

Returns fmri_pipeline – fMRIPipeline object instance
Return type Instance(cmp.pipelines.functional.fMRI.fMRIPipeline)

cmp.project.refresh_folder(bids_directory, derivatives_directory, subject, input_folders, session=None)
Creates (if needed) the folder hierarchy.

Parameters

- bids_directory (os.path) – BIDS dataset root directory
• **derivatives_directory** *(os.path)* – Output (derivatives) directory
• **subject** *(string)* – BIDS subject label (sub-XX)
• **input_folders** *(List of string)* – List of folder to be created in derivatives_directory/'cmp'/subject
• **session** *(string)* – BIDS session label (ses-YY)

cmp.project.run_individual *(bids_dir, output_dir, participant_label, session_label, anat_pipeline_config, dwi_pipeline_config, func_pipeline_config, number_of_threads=1)*

Function that creates the processing pipeline for complete coverage.

**Parameters**

• **bids_dir** *(string)* – BIDS dataset root directory
• **output_dir** *(string)* – Output (derivatives) directory
• **participant_label** *(string)* – BIDS participant / subject label (sub-XX)
• **session_label** *(string)* – BIDS session label (ses-XX)
• **anat_pipeline_config** *(string)* – Path to anatomical pipeline configuration file
• **dwi_pipeline_config** *(string)* – Path to diffusion pipeline configuration file
• **func_pipeline_config** *(string)* – Path to fMRI pipeline configuration file
• **number_of_threads** *(int)* – Number of threads used by programs relying on the OpenMP library

cmp.project.update_anat_last_processed *(project_info, pipeline)*

Update last processing information of an **AnatomicalPipeline**.

**Parameters**

• **project_info** *(cmp.project.CMP_Project_Info)* – Instance of CMP_Project_Info object
• **pipeline** *(cmp.pipelines.anatomical.anatomical.AnatomicalPipeline)* – Instance of AnatomicalPipeline object

cmp.project.update_dmri_last_processed *(project_info, pipeline)*

Update last processing information of an **DiffusionPipeline**.

**Parameters**

• **project_info** *(cmp.project.CMP_Project_Info)* – Instance of CMP.Project_Info object
• **pipeline** *(cmp.pipelines.diffusion.diffusion.DiffusionPipeline)* – Instance of DiffusionPipeline object

cmp.project.update_fmri_last_processed *(project_info, pipeline)*

Update last processing information of an **fMRIPipeline**.

**Parameters**

• **project_info** *(cmp.project.CMP_Project_Info)* – Instance of CMP.Project_Info object
• **pipeline** *(cmp.pipelines.functional.fMRI.fMRIPipeline)* – Instance of fMRIPipeline object
Pipelines and stages modules

cmp.pipelines.common module

Definition of common parent classes for pipelines.

class cmp.pipelines.common.Pipeline(project_info)
    Bases: traits.has_traits.HasTraits
    
    Parent class that extends HasTraits and represents a processing pipeline.
    It is extended by the various pipeline classes.
    See also:
    cmp.pipelines.anatomical.anatomical.AnatomicalPipeline,
    cmp.pipelines.diffusion.diffusion.DiffusionPipeline,
    cmp.pipelines.functional.fMRI.fMRIPipeline

    anat_flow = None
    
    check_config()
        Old method that was checking custom settings (obsolete).

    check_stages_execution()
        Check stage execution.

    clear_stages_outputs()
        Clear processing stage outputs.

    create_stage_flow(stage_name)
        Create the sub-workflow of a processing stage.

        Parameters stage_name --

    fill_stages_outputs()
        Update processing stage output list for visual inspection.

    launch_process()
        Launch the processing.

    number_of_cores = 1
    subject = 'sub-01'

class cmp.pipelines.common.ProcessThread(group=None, target=None, name=None, args=(), kwargs=None, *args, daemon=None)
    Bases: threading.Thread
    
    Class use to represent the pipeline process as a threading.Thread.

    pipeline <Instance>
        Any Pipeline instance

    pipeline = <traits.trait_types.Instance object>

    run()
        Execute the pipeline.

class cmp.pipelines.common.ProgressThread(group=None, target=None, name=None, args=(), kwargs=None, *args, daemon=None)
    Bases: threading.Thread
    
    Class use to monitor stage execution in a threading.Thread.
Information is display in the ProgressWindow (Not used anymore by CMP3)

```python
pw = <traits.trait_types.Instance object>
run()
```

- Monitors stage execution a workflow.

```python
stage_names = []
stages = {}
```

Class `cmp.pipelines.common.ProgressWindow`

Bases: `traits.has_traits.HasTraits`

- Progress window of stage execution

(Not used anymore by CMP3)

### cmp.pipelines.anatomical package

#### Submodules

### cmp.pipelines.anatomical.anatomical module

Anatomical pipeline Class definition.

```python
class cmp.pipelines.anatomical.anatomical.AnatomicalPipeline(project_info)
     Bases: cmp.pipelines.common.Pipeline
```

- Class that extends a Pipeline and represents the processing pipeline for structural MRI.
- It is composed of the segmentation stage that performs FreeSurfer recon-all and the parcellation stage that creates the Lausanne brain parcellations.

See also:

- `cmp.stages.segmentation.segmentation.SegmentationStage`
- `cmp.stages.parcellation.parcellation.ParcellationStage`

```python
check_config()
```

- Check if custom white matter mask and custom atlas files specified in the configuration exist.

  Returns `message` – String empty if all the checks pass, otherwise it contains the error message

  Return type `string`

```python
check_input(layout, gui=True)
```

- Check if input of the anatomical pipeline are available.

  Parameters

  - `layout` (`bids.BIDSLayout`) – Instance of BIDSLayout
  - `gui` (`traits.Bool`) – Boolean used to display different messages but not really meaningful anymore since the GUI components have been migrated to `cmp.bidsappmanager`

  Returns `valid_inputs` – True if inputs are available

  Return type `traits.Bool`

```python
check_output()
```

- Check if outputs of an AnatomicalPipeline are available.
Returns

- `valid_output <Bool>` – True if all outputs are found
- `error_message <string>` – Error message if an output is not found.

```python
define_custom_mapping(custom_last_stage)
    Define the pipeline to be executed until a specific stage.
    Not used yet by CMP3.
```

```python
process()
    Executes the anatomical pipeline workflow and returns True if successful.
```

```python
update_parcellation_scheme()
    Updates parcellation_scheme and atlas_info when parcellation_scheme is updated.
```

```python
update_segmentation()
    Update self.stages['Segmentation'].config.seg_tool when parcellation_scheme is updated.
```

```python
class cmp.pipelines.anatomical.anatomical.Check_Input_Notification
    Bases: traits.has_traits.HasTraits
```

```python
class cmp.pipelines.anatomical.anatomical.Global_Configuration
    Bases: traits.has_traits.HasTraits
```

Global pipeline configurations.

```python
process_type
    Processing pipeline type
    Type ‘anatomical’
```

```python
subjects
    List of subjects ID (in the form sub-XX)
    Type traits.List
```
subject
Subject to be processed (in the form sub-XX)
Type traits.Str

subject_session
Subject session to be processed (in the form ses-YY)
Type traits.Str

cmp.pipelines.diffusion package

Submodules

cmp.pipelines.diffusion.diffusion module

Diffusion pipeline Class definition.

class cmp.pipelines.diffusion.diffusion.DiffusionPipeline(project_info)
Bases: cmp.pipelines.common.Pipeline

Class that extends a Pipeline and represents the processing pipeline for diffusion MRI.

It is composed of the preprocessing stage that preprocesses dMRI, the registration stage that co-registers T1w to the diffusion B0 and projects the parcellations to the native diffusion space, the diffusion stage that estimates tensors or fiber orientation distributions functions from the diffusion signal and reconstructs fiber using tractography, and finally the connectome stage that combines the output tractogram with the parcellations to create the structural connectivity matrices.

See also:


check_config()
Check if the list output formats in the configuration of the connectome stage is not empty.

Returns message – String that is empty if success, otherwise it contains the error message

Return type string

check_input(layout, gui=True)
Check if input of the diffusion pipeline are available.

Parameters

- layout (bids.BIDSLayout) – Instance of BIDSLayout
- gui (traits.Bool) – Boolean used to display different messages but not really meaningful anymore since the GUI components have been migrated to cmp.bidsappmanager

Returns valid_inputs – True if inputs are available

Return type traits.Bool

create_pipeline_flow(cmp_deriv_subject_directory, nipype_deriv_subject_directory)
Create the pipeline workflow.

Parameters
- **cmp_deriv_subject_directory** *(Directory)* – Main CMP output directory of a subject e.g. `/output_dir/cmp/sub-XX/(ses-YY)`

- **nipype_deriv_subject_directory** *(Directory)* – Intermediate Nipype output directory of a subject e.g. `/output_dir/nipype/sub-XX/(ses-YY)`

    Returns **diffusion_flow** – An instance of `nipype.pipeline.engine.Workflow`

    Return type `nipype.pipeline.engine.Workflow`

    **define_custom_mapping**(custom_last_stage)
    
    Define the pipeline to be executed until a specific stages.
    
    Not used yet by CMP3.

    Parameters **custom_last_stage** *(string)* – Last stage to execute. Valid values are: “Preprocessing”, “Registration”, “Diffusion” and “Connectome”.

    ```python
    global_conf = <cmp.pipelines.diffusion.diffusion.Global_Configuration object>
    input_folders = ['anat', 'dwi']
    now = '20210307_0915'
    ordered_stage_list = ['Preprocessing', 'Registration', 'Diffusion', 'Connectome']
    process()
    ```
    
    Executes the diffusion pipeline workflow and returns True if successful.

    **update_outputs_recon**(new)
    
    Update list of of outputs of the diffusion stage when `recon_processing_tool` is updated.
    
    Parameters **new** *(string)* – New value.

    **update_outputs_tracking**(new)
    
    Update list of of outputs of the diffusion stage when `tracking_processing_tool` is updated.
    
    Parameters **new** *(string)* – New value.

    **update_vizualization_layout**(new)
    
    Update list of of outputs of the connectome stage when `circular_layout` is updated.
    
    Parameters **new** *(string)* – New value.

    **update_vizualization_logscale**(new)
    
    Update list of of outputs of the connectome stage when `log_visualization` is updated.
    
    Parameters **new** *(bool)* – New value.

    **class** `cmp.pipelines.diffusion.diffusion.Global_Configuration`
    
    Bases: `traits.has_traits.HasTraits`

    Global pipeline configurations.

    **process_type**
    
    Processing pipeline type

    Type `'fMRI'`

    **subjects**
    
    List of subjects ID (in the form `sub-XX`)

    Type `traits.List`

    **subject**
    
    Subject to be processed (in the form `sub-XX`)

7.5. Packages and modules
Type traits.Str

subject_session
Subject session to be processed (in the form ses-YY)
Type traits.Str

modalities
List of available diffusion modalities read from the acq-<modality> filename keyword
Type traits.List

dmri_bids_acq
Diffusion modality to be processed
Type traits.Str

cmp.pipelines.functional package

Submodules

cmp.pipelines.functional.eeg module

EEG pipeline Class definition

cmp.pipelines.functional.fMRI module

Functional pipeline Class definition.

class cmp.pipelines.functional.fMRI.Global_Configuration
    Bases: traits.has_traits.HasTraits
    Global pipeline configurations.

    process_type
    Processing pipeline type
    Type ‘fMRI’

    imaging_model
    Imaging model used by RegistrationStage
    Type ‘fMRI’

class cmp.pipelines.functional.fMRI.fMRIPipeline(project_info)
    Bases: cmp.pipelines.common.Pipeline
    Class that extends a Pipeline and represents the processing pipeline for structural MRI.

    It is composed of:
    • the preprocessing stage that can perform slice timing correction, deskipping and motion correction
    • the registration stage that co-registered the anatomical T1w scan to the mean BOLD image and projects the parcellations to the native fMRI space
    • the extra-preprocessing stage (FunctionalMRIStage) that can perform nuisance regression and band-pass filtering
    • the connectome stage that extracts the time-series of each parcellation ROI and computes the Pearson’s correlation coefficient between ROI time-series to create the functional connectome.
check_config()
    Check if the fMRI pipeline parameters is properly configured.
    
    Returns message – String that is empty if success, otherwise it contains the error message
    
    Return type string

check_input (layout, gui=True)
    Check if input of the diffusion pipeline are available.
    
    Parameters
    
    • layout (bids.BIDSLayout) – Instance of BIDSLayout
    • gui (traits.Bool) – Boolean used to display different messages but not re-
      ally meaningful anymore since the GUI components have been migrated to cmp.
      bidsappmanager
    
    Returns valid_inputs – True if inputs are available
    
    Return type traits.Bool

create_pipeline_flow (cmp_deriv_subject_directory, nipype_deriv_subject_directory)
    Create the pipeline workflow.
    
    Parameters
    
    • cmp_deriv_subject_directory (Directory) – Main CMP output directory of
      a subject e.g. /output_dir/cmp/sub-XX/(ses-YY)
    • nipype_deriv_subject_directory (Directory) – Intermediate Nipype out-
      put directory of a subject e.g. /output_dir/nipype/sub-XX/(ses-YY)
    
    Returns fMRI_flow – An instance of nipype.pipeline.engine.Workflow
    
    Return type nipype.pipeline.engine.Workflow

define_custom_mapping (custom_last_stage)
    Define the pipeline to be executed until a specific stages.
    
    Not used yet by CMP3.
    
    Parameters custom_last_stage (string) – Last stage to execute. Valid values are:
      “Preprocessing”, “Registration”, “FunctionalMRI” and “Connectome”.

global_conf = <cmp.pipelines.functional.fMRI.Global_Configuration object>
input_folders = ['anat', 'func']
now = '20210307_0915'
ordered_stage_list = ['Preprocessing', 'Registration', 'FunctionalMRI', 'Connectome']

process()
    Executes the fMRI pipeline workflow and returns True if successful.

update_nuisance_requirements()
    Update nuisance requirements.
Configure the registration to apply the estimated transformation to multiple segmentation masks depending on the Nuisance correction steps performed.

```python
update_registration()
```
Configure the list of registration tools.

```python
update_scrubbing()
```
Update to precompute or inputs for scrubbing during the FunctionalMRI stage.

cmp.stages package

Subpackages

cmp.stages.connectome package

Submodules

cmp.stages.connectome.connectome module

Definition of config and stage classes for building structural connectivity matrices.

```python
class cmp.stages.connectome.connectome.ConnectomeConfig
    Bases: traits.has_traits.HasTraits

    Class used to store configuration parameters of a ConnectomeStage instance.

    compute_curvature
        Compute fiber curvature (Default: False)

        Type  traits.Bool

    output_types
        Output connectome format

        Type  ['gPickle', 'mat', 'graphml']

    connectivity_metrics
        Set of connectome maps to compute

        Type  ['Fiber number', 'Fiber length', 'Fiber density', 'Fiber proportion', 'Normalized fiber density', 'ADC', 'gFA']

    log_visualization
        Log visualization that might be obsolete as this has been detached after creation of the bidsappmanager (Default: True)

        Type  traits.Bool

    circular_layout
        Visualization of the connectivity matrix using a circular layout that might be obsolete as this has been detached after creation of the bidsappmanager (Default: False)

        Type  traits.Bool

    subject
        BIDS subject ID (in the form sub-XX)

        Type  traits.Str
```
See also:

cmp.stages.connectome.connectome.ConnectomeStage

class cmp.stages.connectome.connectome.ConnectomeStage(bids_dir, output_dir)
Bases: cmp.stages.common.Stage

Class that represents the connectome building stage of a DiffusionPipeline.

create_workflow()
Create the workflow of the diffusion ConnectomeStage

See also:
cmp.pipelines.diffusion.diffusion.DiffusionPipeline, cmp.stages.connectome.connectome.ConnectomeConfig

create_workflow (flow, inputnode, outputnode)
Create the stage workflow.

Parameters
  • flow (nipype.pipeline.engine.Workflow) – The nipype.pipeline.engine.Workflow instance of the Diffusion pipeline
  • inputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the inputs of the stage
  • outputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the outputs of the stage

define_inspect_outputs ()
Update the `inspect_outputs` class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

has_run ()
Function that returns True if the stage has been run successfully.

Returns
  Return type True if the stage has been run successfully

cmp.stages.connectome.fmri_connectome module

Definition of config and stage classes for building functional connectivity matrices.

class cmp.stages.connectome.fmri_connectome.ConnectomeConfig
Bases: traits.has_traits.HasTraits

Class used to store configuration parameters of a ConnectomeStage instance.

apply_scrubbing
Apply scrubbing before mapping the functional connectome if True (Default: False)
  Type traits.Bool

FD_thr
Framewise displacement threshold (Default: 0.2)
  Type traits.Float

DVARS_thr
DVARS (RMS of variance over voxels) threshold (Default: 4.0)
Type `traits.Float`

`output_types`
Output connectome format

Type `['gPickle', 'mat', 'cff', 'graphml']`

`log_visualization`
Log visualization that might be obsolete as this has been detached after creation of the bidsappmanager (Default: True)

Type `traits.Bool`

`circular_layout`
Visualization of the connectivity matrix using a circular layout that might be obsolete as this has been detached after creation of the bidsappmanager (Default: False)

Type `traits.Bool`

`subject`
BIDS subject ID (in the form `sub-XX`)

Type `traits.Str`

See also:
```
cmp.stages.connectome.fmri_connectome.ConnectomeStage
```

class `cmp.stages.connectome.fmri_connectome.ConnectomeStage`(bids_dir, output_dir)

Bases: `cmp.stages.common.Stage`

Class that represents the connectome building stage of a `fMRIPipeline`.

`create_workflow()`
Create the workflow of the fMRI `ConnectomeStage`

See also:
```
cmp.pipelines.functional.fMRI.fMRIPipeline, cmp.stages.connectome.fmri_connectome.ConnectomeConfig
```

create_workflow(flow, inputnode, outputnode)
Create the stage worflow.

Parameters

- `flow` *(nipype.pipeline.engine.Workflow)* — The nipype.pipeline.engine.Workflow instance of the fMRI pipeline

- `inputnode` *(nipype.interfaces.utility.IdentityInterface)* — Identity interface describing the inputs of the stage

- `outputnode` *(nipype.interfaces.utility.IdentityInterface)* — Identity interface describing the outputs of the stage

`define_inspect_outputs()`
Update the `inspect_outputs` class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

`has_run()`
Function that returns `True` if the stage has been run successfully.

Returns

`Return type` `True` if the stage has been run successfully
cmp.stages.diffusion package

Submodules

cmp.stages.diffusion.diffusion module

Definition of config and stage classes for diffusion reconstruction and tractography.

class cmp.stages.diffusion.diffusion.DiffusionConfig
    Bases: traits.has_traits.HasTraits

    Class used to store configuration parameters of a DiffusionStage instance.

diffusion_imaging_model_editor
    Available diffusion imaging models
    Type ['DSI', 'DTI', 'HARDI', 'multishell']

diffusion_imaging_model
    Selected diffusion imaging model (Default: 'DTI')
    Type traits.Str

dilate_rois
    Dilate parcellation regions-of-interest (Default: True)
    Type traits.Bool

dilation_kernel
    Type of dilation kernel to used
    Type traits.Enum(['Box', 'Gauss', 'Sphere'])

dilation_radius
    Radius of the dilation kernel
    Type traits.Enum([1, 2, 3, 4])

recon_processing_tool_editor
    List of processing tools available for diffusion signal reconstruction
    Type ['Dipy', 'MRtrix']

tracking_processing_tool_editor
    List of processing tools available for tractography
    Type ['Dipy', 'MRtrix']

processing_tool_editor
    List of processing tools available for diffusion signal reconstruction and tractography
    Type ['Dipy', 'MRtrix']

recon_processing_tool
    Processing tool to use for diffusion signal modeling (Default: 'MRtrix')
    Type traits.Str

tracking_processing_tool
    Processing tool to use for tractography (Default: 'MRtrix')
    Type traits.Str
custom_track_file
  Custom tractogram file to used as input to the connectome stage (obsolete)
  
  Type : traits.File

dipy_recon_config
  Configuration instance of the Dipy reconstruction stage
  
  Type : Instance(HasTraits)

mrtrix_recon_config
  Configuration instance of the MRtrix3 reconstruction stage
  
  Type : Instance(HasTraits)

dipy_tracking_config
  Configuration instance of the Dipy tracking (tractography) stage
  
  Type : Instance(HasTraits)

mrtrix_tracking_config
  Configuration instance of the MRtrix3 tracking (tractography) stage
  
  Type : Instance(HasTraits)

diffusion_model_editor
  List of types of available local tractography algorithms.
  
  Type : ['Deterministic', 'Probabilistic']

diffusion_model
  Type of local tractography algorithm to use. (Default: 'Probabilistic')
  
  Type : traits.Str

See also:


update_dipy_tracking_SD(new)
  Update SD of dipy_tracking_config when local_model is updated.

  Parameters new(string) – New value of local_model

update_dipy_tracking_sh_order(new)
  Update sh_order of dipy_tracking_config when lmax_order is updated.

  Parameters new(int) – New value of lmax_order

update_mrtrix_tracking_SD(new)
  Update SD of mrtrix_tracking_config when local_model is updated.

  Parameters new(string) – New value of local_model

class cmp.stages.diffusion.diffusion.DiffusionStage(bids_dir, output_dir)
  Bases: cmp.stages.common.Stage

  Class that represents the diffusion stage of a DiffusionPipeline.

  The diffusion stage workflow is composed of two sub-workflows: 1. recon_flow that estimates tensors or fiber orientation distribution functions from dMRI, 2. track_flow that runs tractography from the output of recon_flow.
create_workflow()

Create the workflow of the DiffusionStage

See also:

Dipy_recon_config, cmp.stages.diffusion.reconstruction.MRtrix_recon_config,
reconstruction.create_dipy_recon_flow, cmp.stages.diffusion.
reconstruction.create_mrtrix_recon_flow, cmp.stages.diffusion.
tracking.create_dipy_tracking_flow, cmp.stages.diffusion.tracking.
create_mrtrix_tracking_flow

create_workflow (flow, inputnode, outputnode)

Create the stage workflow.

Parameters

• flow (nipype.pipeline.engine.Workflow) – The nipype.pipeline.engine.Workflow instance of the Diffusion pipeline

• inputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the inputs of the stage

• outputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the outputs of the stage

See also:

cmp.stages.diffusion.reconstruction.create_dipy_recon_flow(), cmp.stages.
diffusion.reconstruction.create_mrtrix_recon_flow(), cmp.stages.
diffusion.tracking.create_dipy_tracking_flow(), cmp.stages.diffusion.
tracking.create_mrtrix_tracking_flow()

define_inspect_outputs()

Update the 'inspect_outputs' class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

has_run()

Function that returns True if the stage has been run successfully.

Returns

Return type True if the stage has been run successfully

cmp.stages.diffusion.diffusion.strip_suffix (file_input, prefix)

Extract path of file_input and add prefix to generate a prefix path for outputs.

Parameters

• file_input (os.path.abspath) – Absolute path to an input file

• prefix (os.path) – Prefix to used in the generation of the output prefix path.

Returns out_prefix_path – The generated prefix path

Return type os.path
**cmp.stages.diffusion.reconstruction module**

Reconstruction methods and workflows.

```python
class cmp.stages.diffusion.reconstruction.Dipy_recon_config
    Bases: traits.has_traits.HasTraits

    Class used to store Dipy diffusion reconstruction sub-workflow configuration parameters.

    **imaging_model**
    Diffusion imaging model (For instance 'DTI')
    Type Str

    **flip_table_axis**
    Axis to be flipped in the gradient table.
    Type traits.List(['x', 'y', 'z'])

    **local_model_editor**
    List of reconstruction models
    Type {False: '1:Tensor', True: '2:Constrained Spherical Deconvolution'}

    **local_model**
    Reconstruction model selected (See *local_model_editor*) (Default: True, meaning Tensor is performed)
    Type traits.Bool

    **lmax_order**
    Choices of maximal order to use for Constrained Spherical Deconvolution
    Type traits.Enum([2, 4, 6, 8, 10, 12, 14, 16])

    **single_fib_thr**
    FA threshold
    Type traits.Float(0.7, min=0, max=1)

    **recon_mode**
    Can be “Probabilistic” or “Deterministic”
    Type traits.Str

    **mapmri**
    Type traits.Bool(False)

    **tracking_processing_tool**
    Type traits.Enum('MRtrix', 'Dipy')

    **laplacian_regularization**
    Apply laplacian regularization in MAP-MRI if True (Default: True)
    Type traits.Bool

    **laplacian_weighting**
    Laplacian regularization weight in MAP-MRI (Default: 0.05)
    Type traits.Float

    **positivity_constraint**
    Apply positivity constraint in MAP-MRI if True (Default: True)
    Type traits.Bool
```
radial_order
MAP-MRI radial order (Default: 8)
  Type  traits.Int
small_delta
Small data for gradient table (pulse duration) used by MAP-MRI (Default: 0.02)
  Type  traits.Float
big_delta
Big data for gradient table (time interval) used by MAP-MRI (Default: 0.5)
  Type  traits.Float
radial_order_values
Choices of radial order values used by SHORE
  Type  traits.List([2, 4, 6, 8, 10, 12])
shore_radial_order
Even number that represents the order of the basis (Default: 6)
  Type  traits.Str
shore_zeta
Scale factor in SHORE (Default: 700)
  Type  traits.Int
shore_lambda_n
Radial regularisation constant in SHORE (Default: 1e-8)
  Type  traits.Float
shore_lambda_l
Angular regularisation constant in SHORE (Default: 1e-8)
  Type  traits.Float
shore_tau
Diffusion time used by SHORE. By default the value that makes $q$ equal to the square root of the b-value (Default: 0.025330295910584444)
  Type  traits.Float
shore_constrain_e0
Constrain SHORE optimization such that $E(0) = 1$ (Default: False)
  Type  traits.Bool
shore_positive_constraint
Constrain the SHORE propagator to be positive (Default: False)
  Type  traits.Bool
class  cmp.stages.diffusion.reconstruction.MRtrix_recon_config
Bases: traits.has_traits.HasTraits
Class used to store Dipy diffusion reconstruction sub-workflow configuration parameters.
flip_table_axis
Axis to be flipped in the gradient table.
  Type  traits.List(['x', 'y', 'z'])
**local_model_editor**
List of reconstruction models


**local_model**
Reconstruction model selected (See **local_model_editor**) (Default: True, meaning Tensor is performed)

Type traits.Bool

**lmax_order**
Choices of maximal order to use for Constrained Spherical Deconvolution

Type traits.Enum([2, 4, 6, 8, 10, 12, 14, 16])

**single_fib_thr**
FA threshold

Type traits.Float(0.7, min=0, max=1)

**recon_mode**
Can be “Probabilistic” or “Deterministic”

Type traits.Str

**create_dipy_recon_flow**
Create the reconstruction sub-workflow of the DiffusionStage using Dipy.

Parameters config (Dipy_recon_config) – Workflow configuration

Returns flow – Built reconstruction sub-workflow

Return type nipype.pipeline.engine.Workflow

**create_mrtrix_recon_flow**
Create the reconstruction sub-workflow of the DiffusionStage using MRtrix3.

Parameters config (Dipy_recon_config) – Workflow configuration

Returns flow – Built reconstruction sub-workflow

Return type nipype.pipeline.engine.Workflow

**cmp.stages.diffusion.tracking module**
Tracking methods and workflows of the diffusion stage.

**class Dipy_tracking_config**
Class used to store Dipy diffusion reconstruction sub-workflow configuration parameters.

**imaging_model**
Diffusion imaging model (For example ‘DTI’)

Type traits.Str

**tracking_mode**
Type of local tractography algorithm (Can be “Deterministic” or “Probabilistic”)

Type traits.Str

**SD**
If True, inputs are coming from Constrained Spherical Deconvolution reconstruction
Type traits.Bool

**number_of_seeds**  
Number of seeds (Default: 1000)  
Type traits.Int

**seed_density**  
Number of seeds to place along each direction where a density of 2 is the same as [2, 2, 2] and will result in a total of 8 seeds per voxel (Default: 1.0)  
Type traits.Float

**fa_thresh**  
Fractional Anisotropy (FA) threshold (Default: 0.2)  
Type traits.Float

**step_size**  
Tractography algorithm step size (Default: 0.5)  
Type traits.Float

**max_angle**  
Maximum streamline angle allowed (Default: 25.0)  
Type traits.Float

**sh_order**  
Order used for Constrained Spherical Deconvolution reconstruction (Default: 8)  
Type traits.Int

**use_act**  
Use FAST for partial volume estimation and Anatomically-Constrained Tractography (ACT) tissue classifier (Default: False)  
Type traits.Bool

**seed_from_gmwmi**  
Seed from Grey Matter / White Matter interface (requires Anatomically-Constrained Tractography (ACT)) (Default: False)  
Type traits.Bool

**class** cmp.stages.diffusion.tracking.MRtrix_tracking_config  
Bases: traits.has_traits.HasTraits

Class used to store Dipy diffusion reconstruction sub-workflow configuration parameters.

**tracking_mode**  
Type of local tractography algorithm (Can be “Deterministic” or “Probabilistic”)  
Type traits.Str

**SD**  
If True, inputs are coming from Constrained Spherical Deconvolution reconstruction  
Type traits.Bool

**desired_number_of_tracks**  
Desired number of output streamlines in the tractogram (Default: 1M)  
Type traits.Int

5.6. Packages and modules
**curvature = Float**
Maximum streamline curvature (Default: 2.0)

**min_length = Float**
Minimal streamline length (Default: 5)

**max_length = Float**
Maximal streamline length (Default: 500)

**angle**
Maximum streamline angle allowed (Default: 45.0)
  
  **Type** traits.Float

**cutoff_value**
Cut-off value to terminate streamline (Default: 0.05)
  
  **Type** traits.Float

**use_act**
Use 5ttgen for brain tissue types estimation and Anatomically-Constrained Tractography (ACT) tissue classifier (Default: False)
  
  **Type** traits.Bool

**seed_from_gmwmi**
Seed from Grey Matter / White Matter interface (requires Anatomically-Constrained Tractography (ACT)) (Default: False)
  
  **Type** traits.Bool

**crop_at_gmwmi**
Crop streamline endpoints more precisely as they cross the GM-WM interface (requires Anatomically-Constrained Tractography (ACT)) (Default: True)
  
  **Type** traits.Bool

**backtrack**
Allow tracks to be truncated (requires Anatomically-Constrained Tractography (ACT)) (Default: True)
  
  **Type** traits.Bool

**sift**
Filter tractogram using mrtrix3 SIFT (Default: True)
  
  **Type** traits.Bool

```python
cmp.stages.diffusion.tracking.create_dipy_tracking_flow(config)
Create the tractography sub-workflow of the DiffusionStage using Dipy.

**Parameters**

<table>
<thead>
<tr>
<th>config (Dipy_tracking_config)</th>
<th>Sub-workflow configuration object</th>
</tr>
</thead>
</table>

**Returns**

<table>
<thead>
<tr>
<th>flow</th>
<th>Built tractography sub-workflow</th>
</tr>
</thead>
</table>

**Return type**

<table>
<thead>
<tr>
<th>nipype.pipeline.engine.Workflow</th>
</tr>
</thead>
</table>
```

```python
cmp.stages.diffusion.tracking.create_mrtrix_tracking_flow(config)
Create the tractography sub-workflow of the DiffusionStage using MRtrix3.

**Parameters**

<table>
<thead>
<tr>
<th>config (MRtrix_tracking_config)</th>
<th>Sub-workflow configuration object</th>
</tr>
</thead>
</table>

**Returns**

<table>
<thead>
<tr>
<th>flow</th>
<th>Built tractography sub-workflow</th>
</tr>
</thead>
</table>

**Return type**

<table>
<thead>
<tr>
<th>nipype.pipeline.engine.Workflow</th>
</tr>
</thead>
</table>
cmp.stages.diffusion.tracking.get_freesurfer_parcellation(roi_files)
Return the first file in the list of parcellation files

Parameters roi_files (list of traits.File) – List of parcellation files

cmp.stages.functional package

Submodules

cmp.stages.functional.functionalMRI module

Definition of config and stage classes for the extra functional preprocessing stage.

class cmp.stages.functional.functionalMRI.FunctionalMRIConfig
Bases: traits.has_traits.HasTraits

Class used to store configuration parameters of a FunctionalMRIStage object.

global_nuisance
Perform global nuisance regression (Default: False)
Type traits.Bool
csf
Perform CSF nuisance regression (Default: True)
Type traits.Bool
wm
Perform White-Matter nuisance regression (Default: True)
Type traits.Bool
motion
Perform motion nuisance regression (Default: True)
Type traits.Bool
detrending = Bool
Perform detrending (Default: True)
detrending_mode = Enum("linear", "quadratic")
Detrending mode (Default: “Linear”)
lowpass_filter = Float
Lowpass filter frequency (Default: 0.01)
highpass_filter = Float
Highpass filter frequency (Default: 0.1)
scrubbing = Bool
Perform scrubbing (Default: True)

See also:
cmp.stages.functional.functionalMRI.FunctionalMRIStage

class cmp.stages.functional.functionalMRI.FunctionalMRIStage(bids_dir, output_dir)
Bases: cmp.stages.common.Stage

Class that represents the post-registration preprocessing stage of the fMRIPipeline.
create_workflow()
Create the workflow of the FunctionalMRIStage

See also:
cmp.pipelines.functional.fMRI.fMRIPipeline, cmp.stages.functional.functionalMRI.FunctionalMRICfg

create_workflow (flow, inputnode, outputnode)
Create the stage workflow.

Parameters
• flow (nipype.pipeline.engine.Workflow) – The nipype.pipeline.engine.Workflow instance of the fMRI pipeline
• inputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the inputs of the stage
• outputnode (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the outputs of the stage

define_inspect_outputs ()
Update the ‘inspect_outputs’ class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

has_run ()
Function that returns True if the stage has been run successfully.

Returns
Return type True if the stage has been run successfully

cmp.stages.parcellation package

Submodules

cmp.stages.parcellation.parcellation module

Definition of config and stage classes for computing brain parcellation.

class cmp.stages.parcellation.parcellation.ParcellationConfig
Bases: traits.has_traits.HasTraits

Class used to store configuration parameters of a ParcellationStage object.

pipeline_mode
Distinguish if a parcellation is run in a “Diffusion” or in a fMRI pipeline

Type traits.Enum([“Diffusion”, “fMRI”])

parcellation_scheme
Parcellation scheme used (Default: ‘Lausanne2008’)

Type traits.Str

parcellation_scheme_editor
Choice of parcellation schemes

Type traits.List([‘NativeFreesurfer’, ‘Lausanne2008’, ‘Lausanne2018’])
**include_thalamic_nuclei_parcellation**

Perform and include thalamic nuclei segmentation in ‘Lausanne2018’ parcellation (Default: True)

- **Type** traits.Bool

**ants_precision_type**

Specify ANTs used by thalamic nuclei segmentation to adopt single / double precision float representation to reduce memory usage. (Default: ‘double’)

- **Type** traits.Enum(['double', 'float'])

**segment_hippocampal_subfields**

Perform and include FreeSurfer hippocampal subfields segmentation in ‘Lausanne2018’ parcellation (Default: True)

- **Type** traits.Bool

**segment_brainstem**

Perform and include FreeSurfer brainstem segmentation in ‘Lausanne2018’ parcellation (Default: True)

- **Type** traits.Bool

**atlas_info**

Dictionary storing information of atlases in the form >>> atlas_info = {atlas_name: {'number_of_regions': number_of_regions, ‘node_information_graphml': graphml_file}} # doctest: +SKIP

- **Type** traits.Dict

See also:

cmp.stages.parcellation.parcellation.ParcellationStage

**update_atlas_info()**

Update atlas_info class attribute.

class cmp.stages.parcellation.parcellation.ParcellationStage(pipeline_mode, bids_dir, output_dir)

- Bases: cmp.stages.common.Stage

Class that represents the parcellation stage of a AnatomicalPipeline.

**create_workflow()**

Create the workflow of the ParcellationStage

See also:

cmp.pipelines.anatomical.anatomical.AnatomicalPipeline, cmp.stages.parcellation.parcellation.ParcellationConfig

**create_workflow(flow, inputnode, outputnode)**

Create the stage workflow.

**Parameters**

- **flow** (nipype.pipeline.engine.Workflow) – The nipype.pipeline.engine.Workflow instance of the anatomical pipeline

- **inputnode** (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the inputs of the stage

- **outputnode** (nipype.interfaces.utility.IdentityInterface) – Identity interface describing the outputs of the stage
define_inspect_outputs() Update the `inspect_outputs` class attribute.
It contains a dictionary of stage outputs with corresponding commands for visual inspection.

has_run() Function that returns True if the stage has been run successfully.
Returns
Return type True if the stage has been run successfully

cmp.stages.preprocessing package

Submodules

cmp.stages.preprocessing.fmri_preprocessing module

Definition of config and stage classes for pre-registration fMRI preprocessing.

class cmp.stages.preprocessing.fmri_preprocessing.PreprocessingConfig
Bases: traits.has_traits.HasTraits
Class used to store configuration parameters of a PreprocessingStage object.

discard_n_volumes (Default: ‘5’)
Type traits.Int
despiking (Default: True)
Type traits.Bool
slice_timing
Slice acquisition order for slice timing correction that can be: “bottom-top interleaved”, “bottom-top interleaved”, “top-bottom interleaved”, “bottom-top”, and “top-bottom” (Default: “none”)
Type traits.Enum
repetition_time
Repetition time (Default: 1.92)
Type traits.Float
motion_correction
Perform motion correction (Default: True)
Type traits.Bool

See also:
cmp.stages.preprocessing.fmri_preprocessing.PreprocessingStage

class cmp.stages.preprocessing.fmri_preprocessing.PreprocessingStage (bids_dir, out-put_dir)
Bases: cmp.stages.common.Stage
Class that represents the pre-registration preprocessing stage of a FMRIPipeline instance.
create_workflow()

Create the workflow of the PreprocessingStage

See also:

cmp.pipelines.functional.fMRI.fMRIPipeline, cmp.stages.preprocessing.fmri_preprocessing.PreprocessingConfig

create_workflow(flow, inputnode, outputnode)

Create the stage workflow.

Parameters

- **flow** *(nipype.pipeline.engine.Workflow)* — The nipype.pipeline.engine.Workflow instance of the fMRI pipeline
- **inputnode** *(nipype.interfaces.utility.IdentityInterface)* — Identity interface describing the inputs of the stage
- **outputnode** *(nipype.interfaces.utility.IdentityInterface)* — Identity interface describing the outputs of the stage

define_inspect_outputs()

Update the `inspect_outputs` class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

has_run()

Function that returns True if the stage has been run successfully.

Returns

Return type True if the stage has been run successfully

cmp.stages.preprocessing.preprocessing module

CMP preprocessing Stage (not used yet!)

class cmp.stages.preprocessing.preprocessing.PreprocessingConfig

Bases: traits.has_traits.HasTraits

Class used to store configuration parameters of a PreprocessingStage instance.

**total_readout**

Acquisition total readout time used by FSL Eddy (Default: 0.0)

Type traits.Float

description

Description (Default: ‘description’)

Type traits.Str

denoising

Perform diffusion MRI denoising (Default: False)

Type traits.Bool

denoising_algo

Type of denoising algorithm (Default: ‘MRtrix (MP-PCA)’)

Type traits.Enum([‘MRtrix (MP-PCA)’, ‘Dipy (NL-M)’])

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dipy_noise_model
Type of noise model when Dipy denoising is performed that can be: ‘Rician’ or ‘Gaussian’ (Default: ‘Rician’)
   Type traits.Enum

bias_field_correction
Perform diffusion MRI bias field correction (Default: False)
   Type traits.Bool

bias_field_algo
Type of bias field correction algorithm that can be: ‘ANTS N4’ or ‘FSL FAST’ (Default: ‘ANTS N4’)
   Type traits.Enum, ['ANTS N4', 'FSL FAST'])

eddy_current_and_motion_correction
Perform eddy current and motion correction (Default: True)
   Type traits.Bool

eddy_correction_algo
Algorithm used for eddy current correction that can be: ‘FSL eddy_correct’ or ‘FSL eddy’ (Default: ‘FSL eddy_correct’)
   Type traits.Enum

eddy_correct_motion_correction
Perform eddy current and motion correction MIGHT BE OBSOLETE (Default: True)
   Type traits.Bool

partial_volume_estimation
Estimate partial volume maps from brain tissues segmentation (Default: True)
   Type traits.Bool

fast_use_priors
Use priors when FAST is used for partial volume estimation (Default: True)
   Type traits.Bool

resampling
Tuple describing the target resolution (Default: (1, 1, 1))
   Type traits.Tuple

interpolation
Type of interpolation used when resampling that can be: ‘interpolate’, ‘weighted’, ‘nearest’, ‘sinc’, or ‘cubic’ (Default: ‘interpolate’)
   Type traits.Enum

See also:
cmp.stages.preprocessing.preprocessing.PreprocessingStage

class cmp.stages.preprocessing.preprocessing.PreprocessingStage(bids_dir, output_dir)
Bases: cmp.stages.common.Stage
Class that represents the pre-registration preprocessing stage of a DiffusionPipeline instance.
create_workflow()
Create the workflow of the PreprocessingStage
See also:

- `cmp.pipelines.diffusion.diffusion.DiffusionPipeline`
- `cmp.stages.preprocessing.preprocessing.PreprocessingConfig`

`create_workflow(flow, inputnode, outputnode)`
Create the stage workflow.

**Parameters**

- `flow` ([`nipype.pipeline.engine.Workflow`]) – The nipype.pipeline.engine.Workflow instance of the Diffusion pipeline
- `inputnode` ([`nipype.interfaces.utility.IdentityInterface`]) – Identity interface describing the inputs of the stage
- `outputnode` ([`nipype.interfaces.utility.IdentityInterface`]) – Identity interface describing the outputs of the stage

`define_inspect_outputs()`
Update the `inspect_outputs` class attribute.
It contains a dictionary of stage outputs with corresponding commands for visual inspection.

`has_run()`
Function that returns `True` if the stage has been run successfully.

**Returns**

- `Return type` `True` if the stage has been run successfully

**cmp.stages.registration package**

**Submodules**

**cmp.stages.registration.registration module**

Definition of config and stage classes for MRI co-registration

```python
class cmp.stages.registration.registration.RegistrationConfig
    Bases: traits.has_traits.HasTraits

    Class used to store configuration parameters of a RegistrationStage instance.

    pipeline
      Pipeline type (Default: “Diffusion”)  
      Type traits.Enum(['Diffusion', 'fMRI'])

    registration_mode_trait
      Choices of registration tools updated depending on the pipeline type. (Default: ['FSL', 'ANTS'] if “Diffusion”, ['FSL', 'BBregister (FS)'] if “fMRI”)  
      Type traits.List(['FSL', 'ANTS', 'BBregister (FS)'])

    registration_mode
      Registration tool used from the registration_mode_trait list (Default: ‘ANTS’)  
      Type traits.Str

    diffusion_imaging_model
      Diffusion imaging model (‘DTI’ for instance)
```

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Type traits.Str

use_float_precision
Use ‘single’ instead of ‘double’ float representation to reduce memory usage of ANTs (Default: False)
Type traits.Bool

ants_interpolation
Type traits.Enum

ants_bspline_interpolation_parameters
ANTS BSpline interpolation parameters (Default: traits.Tuple(Int(3)))
Type traits.Tuple

ants_gauss_interpolation_parameters
ANTS Gaussian interpolation parameters (Default: traits.Tuple(Float(5), Float(5)))
Type traits.Tuple

ants_multilab_interpolation_parameters
ANTS Multi-label interpolation parameters (Default: traits.Tuple(Float(5), Float(5)))
Type traits.Tuple

ants_lower_quantile
ANTS lower quantile (Default: 0.005)
Type traits.Float

ants_upper_quantile
ANTS upper quantile (Default: 0.995)
Type traits.Float

ants_convergence_thresh
ANTS convergence threshold (Default: 1e-06)
Type traits.Float

ants_convergence_winsize
ANTS convergence window size (Default: 10)
Type traits.Int

ants_linear_gradient_step
ANTS linear gradient step size (Default: 0.1)
Type traits.Float

ants_linear_cost
Metric used by ANTs linear registration phase that can be ‘CC’, ‘MeanSquares’, ‘Demons’, ‘GC’, ‘MI’, or ‘Mattes’ (Default: ‘MI’)
Type traits.Enum

ants_linear_sampling_strategy
ANTS sampling strategy for the linear registration phase that can be ‘None’, ‘Regular’, or ‘Random’ (Default: ‘Regular’)
Type traits.Enum
ants_linear_sampling_perc
Percentage used if random sampling strategy is employed in the linear registration phase (Default: 0.25)

Type traits.Float

ants_perform_syn
(Default: True)

Type traits.Bool

ants_nonlinear_gradient_step
(Default: 0.1)

Type traits.Float

ants_nonlinear_cost
Metric used by ANTs nonlinear (SyN) registration phase that can be ‘CC’, ‘MeanSquares’, ‘Demons’, ‘GC’, ‘MI’, or ‘Mattes’ (Default: ‘CC’)

Type traits.Enum

ants_nonlinear_update_field_variance
Weight to update field variance in ANTs nonlinear (SyN) registration phase (Default: 3.0)

Type traits.Float

ants_nonlinear_total_field_variance
Weight to give to total field variance in ANTs nonlinear (SyN) registration phase (Default: 0.0)

Type traits.Float

flirt_args
FLIRT extra arguments that will be append to the FSL FLIRT command (Default: None)

Type traits.Str

uses_qform
FSL FLIRT uses qform (Default: True)

Type traits.Bool

dof
Specify number of degree-of-freedom to FSL FLIRT (Default: 6)

Type traits.Int

fsl_cost
Metric used by FSL registration that can be ‘mutualinfo’, ‘corratio’, ‘normcorr’, ‘normmi’, ‘leastsq’, or ‘labeldiff’ (Default: ‘normmi’)

Type traits.Enum

no_search
Enable FSL FLIRT “no search” option (Default: True)

Type traits.Bool

init
Initialization type of FSL registration: ‘spm’, ‘fsl’, or ‘header’ (Default: ‘smp’)

Type traits.Enum(‘header’, [‘spm’, ‘fsl’, ‘header’])

contrast_type
Contrast type specified to BBRegister: ‘t1’, ‘t2’, or ‘dti’ (Default: ‘dti’)

Type traits.Enum(‘dti’, [‘t1’, ‘t2’, ‘dti’])
apply_to_eroded_wm
    Apply estimated transform to eroded white-matter mask (Default: True)
    Type traits.Bool

apply_to_eroded_csf
    Apply estimated transform to eroded cortico spinal fluid mask (Default: True)
    Type traits.Bool

apply_to_eroded_brain
    Apply estimated transform to eroded brain mask (Default: False)
    Type traits.Bool

See also:
    cmp.stages.registration.registration.RegistrationStage

class cmp.stages.registration.registration.RegistrationStage(pipeline_mode,
    fs_subjects_dir=None,
    fs_subject_id=None,
    bids_dir='',
    output_dir='')

Bases: cmp.stages.common.Stage

Class that represents the registration stage of both.DiffusionPipeline and fMRIPipeline.

fs_subjects_dir
    Freesurfer subjects directory (needed by BBRegister)
    Type traits.Directory

fs_subject_id
    Freesurfer subject (being processed) directory (needed by BBRegister)
    Type traits.Str

create_workflow()
    Create the workflow of the RegistrationStage

See also:
functional.fMRI.fMRIPipeline,        cmp.stages.registration.registration.
RegistrationConfig

create_workflow(flow, inputnode, outputnode)
    Create the stage workflow.

Parameters
    • flow (nipype.pipeline.engine.Workflow) – The
      nipype.pipeline.engine.Workflow instance of either the Diffusion pipeline or the
      fMRI pipeline
    • inputnode (nipype.interfaces.utility.IdentityInterface) – Iden-
      tity interface describing the inputs of the stage
    • outputnode(nipype.interfaces.utility.IdentityInterface) – Iden-
      tity interface describing the outputs of the stage

define_inspect_outputs()
    Update the ‘inspect_outputs’ class attribute.
    It contains a dictionary of stage outputs with corresponding commands for visual inspection.
has_run()
    Function that returns True if the stage has been run successfully.

    Returns
    Return type True if the stage has been run successfully

cmp.stages.registration.registration.unicode2str(text)
Convert a unicode to a string using system’s encoding.
    (This methods should be moved to utils in the upcoming future.)

    Parameters text (bytes) – Unicode bytes representation of a string
    Returns out_str – Output string
    Return type str

cmp.stages.segmentation package

Submodules

cmp.stages.segmentation.segmentation module

Definition of config and stage classes for segmentation.

class cmp.stages.segmentation.segmentation.SegmentationConfig
    Bases: traits.has_traits.HasTraits
    Class used to store configuration parameters of a SegmentationStage object.

    seg_tool
        Choice of segmentation tool that can be “Freesurfer”
        Type traits.Enum(“Freesurfer”)

    make_isotropic
        Resample to isotropic resolution (Default: False)
        Type traits.Bool

    isotropic_vox_size
        Isotropic resolution to be resampled (Default: 1.2, desc=”)
        Type traits.Float

    isotropic_interpolation
        Interpolation type used for resampling that can be: ‘cubic’, ‘weighted’, ‘nearest’, ‘sinc’, or ‘interpolate’,
        (Default: ‘cubic’)
        Type traits.Enum

    brain_mask_extraction_tool
        Choice of brain extraction tool: “Freesurfer”, “BET”, or “ANTs” (Default: Freesurfer)
        Type traits.Enum

    ants_templatefile
        Anatomical template used by ANTS brain extraction
        Type traits.File
**ants_probmaskfile**
Brain probability mask used by ANTS brain extraction

*Type* traits.File

**ants_regmaskfile**
Mask (defined in the template space) used during registration in ANTs brain extraction. To limit the metric computation to a specific region.

*Type* traits.File

**use_fsl_brain_mask**
Use FSL BET for brain extraction (Default: False)

*Type* traits.Bool

**brain_mask_path**
Custom brain mask path

*Type* traits.File

**use_existing_freesurfer_data**
(Default: False)

*Type* traits.Bool

**freesurfer_subjects_dir**
Freesurfer subjects directory path usually /output_dir/freesurfer

*Type* traits.Str

**freesurfer_subject_id**
Freesurfer subject (being processed) ID in the form sub-XX(_ses-YY)

*Type* traits.Str

**freesurfer_args**
Extra Freesurfer recon-all arguments

*Type* traits.Str

**white_matter_mask**
Custom white-matter mask

*Type* traits.File

**number_of_threads**
Number of threads leveraged by OpenMP and used in the stage by Freesurfer and ANTs (Default: 1)

*Type* traits.Int

See also:

`cmp.stages.segmentation.segmentation.SegmentationStage`

class `cmp.stages.segmentation.segmentation.SegmentationStage(bids_dir, output_dir)`

Bases: `cmp.stages.common.Stage`

Class that represents the segmentation stage of a *AnatomicalPipeline*.

**create_workflow()**
Create the workflow of the *SegmentationStage*
create_workflow (flow, inputnode, outputnode)

Create the stage workflow.

Parameters

- **flow** *(nipyte.pipeline.engine.Workflow)* – The
  nipyte.pipeline.engine.Workflow instance of the anatomical pipeline

- **inputnode** *(nipyte.interfaces.utility.IdentityInterface)* – Iden-
  tity interface describing the inputs of the stage

- **outputnode** *(nipyte.interfaces.utility.IdentityInterface)* – Iden-
  tity interface describing the outputs of the stage

**define_inspect_outputs**(debug=False)

Update the `inspect_outputs` class attribute.

It contains a dictionary of stage outputs with corresponding commands for visual inspection.

Parameters **debug**(bool) – If True, show printed output

**has_run**()

Function that returns True if the stage has been run successfully.

Returns

Return type True if the stage has been run successfully

**extract_base_directory**(file)

Extract Recon-all base directory from a file.

Parameters **file**(File) – File generated by Recon-all

Returns **out_path** – Recon-all base directory

Return type string

Submodules

cmp.stages.common module

Definition of common parent classes for stages.

**class cmp.stages.common.Stage**

Bases: traits.has_traits.HasTraits

Parent class that extends HasTraits and represents a processing pipeline stage.

It is extended by the various pipeline stage subclasses.

**bids_dir**

BIDS dataset root directory

Type traits.Str

**output_dir**

Output directory

Type traits.Str
**inspect_outputs**

Dictionary of stage outputs with corresponding commands for visual inspection (Initialization: ‘Outputs not available’)

Type traits.Dict

**inspect_outputs_enum**

Choice of output to be visually inspected (values=’inspect_outputs’)

Type traits.Enum

**enabled**

Stage enabled in the pipeline (Default: True)

Type traits.Bool

**config**

Instance of stage configuration

Type Instance(HasTraits)

See also:


```python
enabled = True
inspect_outputs = ['Outputs not available']
```

**is_running**

Return the number of unfinished files in the stage.

Returns **nb_of_unfinished_files** – Number of unfinished files in the stage

Return type int

### GUI modules

**cmp.bidsappmanager.core module**

Core module providing a `run()` command.

```python
cmp.bidsappmanager.core.run(command, env=None, cwd=None)
```

Function calls by CMP_MainWindowHandler to run datalad commands.

It runs the command specified as input via subprocess.run().

Parameters

- **command**(string) – String containing the command to be executed (required)
- **env**(os.environ) – Specify a custom os.environ
- **cwd**(os.path) – Specify a custom current working directory
Examples

```python
>>> cmd = 'datalad save'
>>> run(cmd)
```

cmp.bidsappmanager.gui module

Connectome Mapper GUI.

class cmp.bidsappmanager.gui.CMP_BIDSAppWindow

```python
cmp.bidsappmanager.gui.CMP_BIDSAppWindow(project_info=None,
bids_root='', subjects=None,
list_of_subjects_to_be_processed=None,
anat_config='', dmri_config='',
fmri_config='')
```

Bases: traits.has_traits.HasTraits

Class that defines the Window of the BIDS App Interface.

project_info

Instance of CMP_Project_Info that represents the processing project

Type CMP_Project_Info

bids_root

BIDS root dataset directory

Type traits.Directory

output_dir

Output directory

Type traits.Directory

subjects

List of subjects (in the form sub-XX) present in the dataset

Type traits.List

number_of_participants_processed_in_parallel

Number of participants / subjects to be processed in parallel that takes values in the [1, # of CPUs - 1] range

Type traits.Range

number_threads_max

Maximal number of threads to be used by OpenMP programs (4 by default)

Type traits.Int

number_of_threads

Number of threads to be used by OpenMP programs that takes values in the [1, number_threads_max] range

Type traits.Range

fs_file

Path to Freesurfer license file

Type traits.File

list_of_subjects_to_be_processed

Selection of subjects to be processed from the subjects list
Type List(Str)

dmri_inputs_checked
True if dMRI data is available in the dataset
   Type traits.Bool

fmri_inputs_checked
True if fMRI data is available in the dataset
   Type traits.Bool

anat_config
Configuration file for the anatomical MRI pipeline
   Type traits.File

dmri_config
Configuration file for the diffusion MRI pipeline
   Type traits.File

fmri_config
Configuration file for the functional MRI pipeline
   Type traits.File

run_anat_pipeline
If True, run the anatomical pipeline
   Type traits.Bool

run_dmri_pipeline
If True, run the diffusion pipeline
   Type traits.Bool

run_fmri_pipeline
If True, run the functional pipeline
   Type traits.Bool

bidsapp_tag
Selection of BIDS App version to use
   Type traits.Enum

data_provenance_tracking
If set and if datalad_is_available is True run the BIDS App using datalad (False by default)
   Type traits.Bool

datalad_update_environment
If True and data_provenance_tracking is True, tell to datalad to update the BIDS App container image if there was a previous execution (True by default)
   Type traits.Bool

datalad_is_available
Boolean used to store if datalad is available in the computing environment (False by default)
   Type traits.Bool

check
Button to check if all parameters are properly set for execution of the BIDS App
   Type traits.ui.Button
**start_bidsapp**

Button to run the BIDS App

*Type* traits.ui.Button

**traits_view**

TraitsUI QtView that describes the content of the window

*Type* QtView

**check_settings()**

Checks if all the parameters of the BIDS App run are properly set before execution.

**classmethod manage_bidsapp_procs (proclist)**

Manage parallelized process at the participant level

*Parameters*

- **proclist** (*List of subprocess.Popen*) – List of Popen processes

**number_of_parallel_procs_updated (new)**

Callback function when *number_of_parallel_procs* is updated.

**classmethod run (command, env=None, cwd='/home/docs/checkouts/readthedocs.org/user_builds/connectome-mapper-3/checkouts/latest/docs')**

Function to run datalad commands.

It runs the command specified as input via `subprocess.run()`.

*Parameters*

- **command** (*string*) – String containing the command to be executed (required)
- **env** (*os.environ*) – Specify a custom `os.environ`
- **cwd** (*os.path*) – Specify a custom current working directory

**Examples**

```python
>>> cmd = 'datalad save -m my dataset change message'
>>> run(cmd)
```

**start_bids_app()**

Function executed when the Run BIDS App button is clicked.

It implements all steps in the creation and execution of the BIDS App with or without datalad.

**start_bidsapp_participant_level_process (bidsapp_tag, participant_labels)**

Create and run the BIDS App command.

*Parameters*

- **bidsapp_tag** (*traits.Str*) – Version tag of the CMP 3 BIDS App
- **participant_labels** (*traits.List*) – List of participants labels in the form ["01", "03", "04", ...]

**start_bidsapp_participant_level_process_with_datalad (bidsapp_tag, participant_labels)**

Create and run the BIDS App command with Datalad.

*Parameters*

- **bidsapp_tag** (*traits.Str*) – Version tag of the CMP 3 BIDS App
• **participant_labels** *(traits.List)* – List of participants labels in the form
[“01”, “03”, “04”, …]

**update_checksettings** *(new)*
   Function that reset settings_checked attribute to False.

**update_run_anat_pipeline** *(new)*
   Callback function when run_anat_pipeline is updated.

**update_run_dmri_pipeline** *(new)*
   Callback function when run_dmri_pipeline is updated.

**update_run_fmri_pipeline** *(new)*
   Callback function when run_fmri_pipeline is updated.

```python
class cmp.bidsappmanager.gui.CMP_ConfiguratorWindow
```

```python
(project_info=None, anat_pipeline=None, dmri_pipeline=None, fmri_pipeline=None, anat_inputs_checked=False, dmri_inputs_checked=False, fmri_inputs_checked=False)
```

Bases: traits.has_traits.HasTraits

Class that defines the Configurator Window.

**project_info**
   Instance of CMP_Project_Info that represents the processing project

   Type `CMP_Project_Info`

**anat_pipeline**
   Instance of anatomical MRI pipeline UI

   Type `Instance(HasTraits)`

**dmri_pipeline**
   Instance of diffusion MRI pipeline UI

   Type `Instance(HasTraits)`

**fmri_pipeline**
   Instance of functional MRI pipeline UI

   Type `Instance(HasTraits)`

**anat_inputs_checked**
   Boolean that indicates if anatomical pipeline inputs are available (Default: False)

   Type traits.Bool

**dmri_inputs_checked** = [traits.Bool] Boolean that indicates if diffusion pipeline inputs are available (Default: False)

   Type traits.Bool

**fmri_inputs_checked** = [traits.Bool] Boolean that indicates if functional pipeline inputs are available (Default: False)

   Type traits.Bool

**anat_save_config**
   TraitsUI Action to save the anatomical pipeline configuration

   Type traits.ui.Action
dmri_save_config
TraitsUI Action to save the diffusion pipeline configuration
  Type traits.ui.Action

fmri_save_config
TraitsUI Action to save the functional pipeline configuration
  Type traits.ui.Action

save_all_config
Button to save all configuration files at once
  Type traits.ui.Button

traits_view
TraitsUI QtView that describes the content of the window
  Type QtView

update_diffusion_imaging_model (new)

```python
class cmp.bidsappmanager.gui.CMP_InspectorWindow (project_info=None,
anat_inputs_checked=False,
dmri_inputs_checked=False,
fmri_inputs_checked=False)
```

Bases: traits.has_traits.HasTraits

Class that defines the Configurator Window.

project_info
  Instance of CMP_Project_Info that represents the processing project
  Type CMP_Project_Info

anat_pipeline
  Instance of anatomical MRI pipeline
  Type Instance(HasTraits)

dmri_pipeline
  Instance of diffusion MRI pipeline
  Type Instance(HasTraits)

fmri_pipeline
  Instance of functional MRI pipeline
  Type Instance(HasTraits)

anat_inputs_checked
  Indicates if inputs of anatomical pipeline are available (Default: False)
  Type traits.Bool

dmri_inputs_checked
  Indicates if inputs of diffusion pipeline are available (Default: False)
  Type traits.Bool

fmri_inputs_checked
  Indicates if inputs of functional pipeline are available (Default: False)
  Type traits.Bool

output_anat_available
  Indicates if outputs of anatomical pipeline are available (Default: False)
Type traits.Bool

output_dmri_available
Indicates if outputs of diffusion pipeline are available (Default: False)

Type traits.Bool

output_fmri_available
Indicates if outputs of functional pipeline are available (Default: False)

Type traits.Bool

traits_view
TraitsUI QtView that describes the content of the window

Type QtView

select_subject()
Function to select the subject and session for which to inspect outputs.

update_diffusion_imaging_model(new)
Function called when diffusion_imaging_model is updated.

class cmp.bidsappmanager.gui.CMP_MainWindow
Bases: traits.has_traits.HasTraits

Class that defines the Main window of the Connectome Mapper 3 GUI.

project_info
Instance of CMP_Project_InfoUI that represents the processing project

Type CMP_Project_InfoUI

anat_pipeline
Instance of anatomical MRI pipeline UI

Type Instance(HasTraits)

dmri_pipeline
Instance of diffusion MRI pipeline UI

Type Instance(HasTraits)

fmri_pipeline
Instance of functional MRI pipeline UI

Type Instance(HasTraits)

bidsapp_ui
Instance of CMP_BIDSAppWindow

Type CMP_Project_Info

load_dataset
TraitsUI Action to load a BIDS dataset

Type traits.ui.Action

bidsapp
Button that displays the BIDS App Interface window

Type traits.ui.Button

configurator
Button that displays the pipeline Configurator window

Type traits.ui.Button
quality_control
Button that displays the pipeline Quality Control / Inspector window
Type traits.ui.Button

manager_group
TraitsUI View that describes the content of the main window
Type traits.ui.View

traits_view
TraitsUI QtView that includes manager_group and parameterize the window with menu
Type QtView

view_mode = 1
class cmp.bidsappmanager.gui.CMP_Project_InfoUI
  Bases: cmp.project.CMP_Project_Info
  Class that extends the CMP_Project_Info with graphical components.
  It supports graphically the setting of all processing properties / attributes of an CMP_Project_Info instance.

creation_mode
Mode for loading the dataset. Valid values are ‘Load BIDS dataset’, ‘Install Datalad BIDS dataset’
Type traits.Enum

install_datalad_dataset_via_ssh
If set to True install the datalad dataset from a remote server via ssh.(True by default)
Type traits.Bool

ssh_user
Remote server username. (Required if install_datalad_dataset_via_ssh is True)
Type traits.Str

ssh_pwd <traits.Password>
Remote server password. (Required if install_datalad_dataset_via_ssh is True)

ssh_remote
Remote server IP or URL. (Required if install_datalad_dataset_via_ssh is True)
Type traits.Str

datalad_dataset_path
Path to the datalad dataset on the remote server. (Required if install_datalad_dataset_via_ssh is True)
Type traits.Directory

summary_view_button
Button that shows the pipeline processing summary table
Type traits.ui.Button

pipeline_processing_summary_view
TraitsUI VGroup that contains Item('pipeline_processing_summary')
Type traits.ui.VGroup

dataset_view
TraitsUI View that shows a summary of project settings and modality available for a given subject
Type traits.ui.View

traits_view
TraitsUI QtView that includes the View `dataset_view`
Type QtView

create_view
Dialog view to create a BIDS Dataset
Type traits.ui.View

subject_view
Dialog view to select of subject
Type traits.ui.View

subject_session_view
Dialog view to select the subject session
Type traits.ui.View

dmri_bids_acq_view
Dialog view to select the diffusion acquisition model
Type traits.ui.View

anat_warning_view
View that displays a warning message regarding the anatomical T1w data
Type traits.ui.View

anat_config_error_view
Error view that displays an error message regarding the configuration of the anatomical pipeline
Type traits.ui.View

dmri_warning_view
View that displays a warning message regarding the diffusion MRI data
Type traits.ui.View

dmri_config_error_view
View that displays an error message regarding the configuration of the diffusion pipeline
Type traits.ui.View

fmri_warning_view
View that displays a warning message regarding the functional MRI data
Type traits.ui.View

fmri_config_error_view
View that displays an error message regarding the configuration of the fMRI pipeline
Type traits.ui.View

open_view
Dialog view to load a BIDS Dataset
Type traits.ui.View

anat_select_config_to_load
Dialog view to load the configuration file of the anatomical pipeline
Type traits.ui.View
diffusion_imaging_model_select_view
Dialog view to select the diffusion acquisition model
Type traits.ui.View
dmri_select_config_to_load
Dialog view to load the configuration file of the diffusion MRI pipeline
Type traits.ui.View
fmri_select_config_to_load
Dialog view to load the configuration file of the fMRI pipeline
Type traits.ui.View
class cmp.bidsappmanager.gui.MultiSelectAdapter
Bases: traitsui.tabular_adapter.TabularAdapter
This adapter is used by left and right tables for selection of subject to be processed.
cmp.bidsappmanager.gui.get_icon(path)
Return an instance of ImageResource or None is there is not graphical backend.
Parameters path (string) – Path to an image file
Returns icon – Return an instance of ImageResource or None is there is not graphical backend.
Return type ImageResource
cmp.bidsappmanager.project module
Connectome Mapper Controller for handling GUI and non GUI general events.
class cmp.bidsappmanager.project.CMP_BIDSAppWindowHandler
Bases: traitsui.handler.Handler
Event handler of the BIDS App Interface window.
docker_process
Instance of subprocess.Popen where BIDS App docker image is run
Type subprocess.Popen
check_settings(ui_info)
Function that checks if all parameters are properly set before execution of the BIDS App.
Parameters ui_info (QtView) – TraitsUI QtView associated with self
classmethod manage_bidsapp_procs(proclist)
Function that managed the parallelized BIDS App Popen process.
Parameters proclist – List of Popen processes running the BIDS App on a single subject
start_bids_app(ui_info)
Main function that runs the BIDS App on a set or sub-set of participants.
Parameters ui_info (QtView) – TraitsUI QtView associated with this handler
classmethod start_bidsapp_process(participant_label)
Function that runs the BIDS App on a single subject.
Parameters
• ui_info (QtView) – TraitsUI QtView associated with this handler
• **participant_label** *(string)* – Label of the participant / subject (e.g. "01", no "sub-") prefix

```python
classmethod stop_bids_app()
    Function that stops the BIDS execution.
```

**Parameters**

- `ui_info` *(QtView)* – TraitsUI QtView associated with this handler

```python
class cmp.bidsappmanager.project.CMP_ConfigQualityWindowHandler
    Bases: traitsui.handler.Handler
```

Event handler of the Configurator and Inspector (Quality Control) windows.

- **project_loaded**
  Indicate if project has been successfully loaded (Default: False)
  ```python
  Type traits.Bool
  ```

- **anat_pipeline**
  Instance of AnatomicalPipelineUI class
  ```python
  Type Instance(HasTraits)
  ```

- **anat_inputs_checked**
  Indicate if anatomical pipeline inputs are available (Default: False)
  ```python
  Type traits.Bool
  ```

- **anat_outputs_checked**
  Indicate if anatomical pipeline outputs are available (Default: False)
  ```python
  Type traits.Bool
  ```

- **anatomical_processed**
  Indicate if anatomical pipeline was run (Default: False)
  ```python
  Type traits.Bool
  ```

- **dmri_pipeline**
  Instance of DiffusionPipelineUI class
  ```python
  Type Instance(HasTraits)
  ```

- **dmri_inputs_checked**
  Indicate if diffusion pipeline inputs are available (Default: False)
  ```python
  Type traits.Bool
  ```

- **dmri_processed**
  Indicate if diffusion pipeline was run (Default: False)
  ```python
  Type traits.Bool
  ```

- **fmri_pipeline**
  Instance of fMRIPipelineUI class
  ```python
  Type Instance(HasTraits)
  ```

- **fmri_inputs_checked**
  Indicate if fMRI pipeline inputs are available (Default: False)
  ```python
  Type traits.Bool
  ```

- **fmri_processed**
  Indicate if fMRI pipeline was run (Default: False)
  ```python
  Type traits.Bool
  ```
load_anat_config_file \((ui\_info)\)
Function that loads the anatomical pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

load_dmri_config_file \((ui\_info)\)
Function that loads the diffusion pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

load_fmri_config_file \((ui\_info)\)
Function that loads the fMRI pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

load_project \((ui\_info)\)
Function that creates a new CMP_Project_InfoUI instance from an existing project.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

new_project \((ui\_info)\)
Function that creates a new CMP_Project_InfoUI instance.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

classmethod save_anat_config_file \((ui\_info)\)
Function that saves the anatomical pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

classmethod save_dmri_config_file \((ui\_info)\)
Function that saves the diffusion pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

classmethod save_fmri_config_file \((ui\_info)\)
Function that saves the fMRI pipeline configuration file.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

classmethod show_bidsapp_window ()
Function that shows the BIDS App Interface Window.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with this handler

update_subject_anat_pipeline \((ui\_info)\)
Function that updates attributes of the AnatomicalPipelineUI instance.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

update_subject_dmri_pipeline \((ui\_info)\)
Function that updates attributes of the DiffusionPipelineUI instance.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

update_subject_fmri_pipeline \((ui\_info)\)
Function that updates attributes of the fMRIPipelineUI instance.

**Parameters**

\(ui\_info\) (QtView) – TraitsUI QtView associated with self

#### class cmp.bidsappmanager.project.CMP_MainWindowHandler
**Bases:** traitsui.handler.Handler

Event handler of the Configurator and Inspector (Quality Control) windows.

**project_loaded**
Indicate if project has been successfully loaded (Default: False)
Type traits.Bool

anat_pipeline
Instance of AnatomicalPipelineUI class
Type Instance(HasTraits)

anat_inputs_checked
Indicate if anatomical pipeline inputs are available (Default: False)
Type traits.Bool

anat_outputs_checked
Indicate if anatomical pipeline outputs are available (Default: False)
Type traits.Bool

anatomical_processed
Indicate if anatomical pipeline was run (Default: False)
Type traits.Bool

dmri_pipeline
Instance of DiffusionPipelineUI class
Type Instance(HasTraits)

dmri_inputs_checked
Indicate if diffusion pipeline inputs are available (Default: False)
Type traits.Bool

dmri_processed
Indicate if diffusion pipeline was run (Default: False)
Type traits.Bool

fmri_pipeline
Instance of fMRIPipelineUI class
Type Instance(HasTraits)

fmri_inputs_checked
Indicate if fMRI pipeline inputs are available (Default: False)
Type traits.Bool

fmri_processed
Indicate if fMRI pipeline was run (Default: False)
Type traits.Bool

load_dataset(ui_info, debug=False)
Function that creates a new CMP_Project_InfoUI instance from an existing project.

Parameters

• ui_info (QtView) – TraitsUI QtView associated with self
• debug (bool) – If True, print more information for debugging

cmp.bidsappmanager.project.clean_cache(bids_root)
Clean cache stored in /tmp.

Target issue related to that a dataset directory is mounted into /tmp and used for caching by java/matlab/matplotlib/xvfb-run in the container image.
Parameters **bids_root** (*string*) – BIDS root dataset directory

cmp.bidsappmanager.project.*init_anat_project*(*project_info, is_new_project*)

Create and initialize a `AnatomicalPipelineUI` instance

Parameters

- **project_info** (*CMP_Project_InfoUI*) – Instance of `CMP_Project_InfoUI` class
- **is_new_project** (*bool*) – If True, this is a new project which has been never processed

cmp.bidsappmanager.project.*init_dmri_project*(*project_info, bids_layout, is_new_project, gui=True*)

Create and initialize a `DiffusionPipelineUI` instance

Parameters

- **project_info** (*CMP_Project_InfoUI*) – Instance of `CMP_Project_InfoUI` class
- **bids_layout** (*bids.BIDSLayout*) – PyBIDS BIDS Layout object describing the BIDS dataset
- **is_new_project** (*bool*) – If True, this is a new project which has been never processed
- **gui** (*bool*) – If True, display messages in GUI

cmp.bidsappmanager.project.*init_fmri_project*(*project_info, bids_layout, is_new_project, gui=True*)

Create and initialize a `fMRIPipelineUI` instance

Parameters

- **project_info** (*CMP_Project_InfoUI*) – Instance of `CMP_Project_InfoUI` class
- **bids_layout** (*bids.BIDSLayout*) – PyBIDS BIDS Layout object describing the BIDS dataset
- **is_new_project** (*bool*) – If True, this is a new project which has been never processed
- **gui** (*bool*) – If True, display messages in GUI

cmp.bidsappmanager.project.*is_tool*(*name*)

Check whether name is on PATH.

cmp.bidsappmanager.project.*refresh_folder*(*derivatives_directory, subject, input_folders, session=None*)

Creates (if needed) the folder hierarchy.

Parameters

- **derivatives_directory** (*string*) –
- **subject** (*string*) – Subject label (sub-XX) for which we create the output folder hierarchy
- **session** (*string*) – Subject session label (ses-YY)
- **input_folders** (*list of string*) – List of folders to create in `derivative_directory/sub-XX/(ses-YY)/` folder for the given subject

cmp.bidsappmanager.project.*update_anat_last_processed*(*project_info, pipeline*)

Update anatomical pipeline processing information

Parameters
• project_info (CMP_Project_InfoUI) – Instance of CMP_Project_InfoUI class
• pipeline (AnatomicalPipelineUI) – Instance of AnatomicalPipelineUI

cmp.bidsappmanager.project.update_dmri_last_processed(project_info, pipeline)
Update diffusion pipeline processing information

Parameters
• project_info (CMP_Project_InfoUI) – Instance of CMP_Project_InfoUI class
• pipeline (DiffusionPipelineUI) – Instance of DiffusionPipelineUI

cmp.bidsappmanager.project.update_fmri_last_processed(project_info, pipeline)
Update functional MRI pipeline processing information

Parameters
• project_info (CMP_Project_InfoUI) – Instance of CMP_Project_InfoUI class
• pipeline (fMRIPipelineUI) – Instance of fMRIPipelineUI

cmp.bidsappmanager.pipelines.anatomical package

Submodules

cmp.bidsappmanager.pipelines.anatomical.anatomical module

Anatomical pipeline UI Class definition.

class cmp.bidsappmanager.pipelines.anatomical.anatomical.AnatomicalPipelineUI(project_info)
    Bases: cmp.pipelines.anatomical.anatomical.AnatomicalPipeline

    Class that extends the AnatomicalPipeline with graphical components.

    segmentation
        Button to open the window for configuration or quality inspection of the segmentation stage depending on
        the view_mode
        Type traits.ui.Button

    parcellation
        Button to open the window for configuration or quality inspection of the segmentation stage depending on
        the view_mode
        Type traits.ui.Button

    view_mode
        Variable used to control the display of either (1) the configuration or (2) the quality inspection of stage of
        the pipeline
        Type ['config_view', 'inspect_outputs_view']

    pipeline_group
        Panel defining the layout of the buttons of the stages with corresponding images
        Type traitsUI panel
traits_view
QtView that includes the pipeline_group panel
  Type QtView
See also:
cmp.pipelines.anatomical.anatomical.AnatomicalPipeline

check_input (layout, gui=True)
Method that checks if inputs of the anatomical pipeline are available in the datasets.
  Parameters
    • layout (bids.BIDSLayout) – BIDSLayout object used to query
    • gui (Boolean) – If True display messages and errors in graphical window
  Returns valid_inputs – True in all inputs of the anatomical pipeline are available
  Return type bool

check_output()
Method that checks if outputs of the anatomical pipeline are available.
  Returns
    • valid_output (bool) – True is all outputs are found
    • error_message (string) – Message in case there is an error

class cmp.bidsappmanager.pipelines.anatomical.anatomical.Check_Input_NotificationUI
Bases: cmp.pipelines.anatomical.anatomical.Check_Input_Notification

cmp.bidsappmanager.pipelines.diffusion package

Submodules

cmp.bidsappmanager.pipelines.diffusion.diffusion module

Diffusion pipeline UI Class definition.

class cmp.bidsappmanager.pipelines.diffusion.diffusion.DiffusionPipelineUI (project_info)
Bases: cmp.pipelines.diffusion.diffusion.DiffusionPipeline
Class that extends the DiffusionPipeline with graphical components.
  preprocessing
    Button to open the window for configuration or quality inspection of the preprocessing stage depending on the view_mode
    Type traits.ui.Button
  registration
    Button to open the window for configuration or quality inspection of the registration stage depending on the view_mode
    Type traits.ui.Button
  diffusion
    Button to open the window for configuration or quality inspection of the diffusion reconstruction and tractography stage depending on the view_mode

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**Type** traits.ui.Button

**connectome**
Button to open the window for configuration or quality inspection of the connectome stage depending on the `view_mode`

**Type** traits.ui.Button

**view_mode**
Variable used to control the display of either (1) the configuration or (2) the quality inspection of stage of the pipeline

**Type** ['config_view', 'inspect_outputs_view']

**pipeline_group**
Panel defining the layout of the buttons of the stages with corresponding images

**Type** traitsUI panel

**traits_view**
QtView that includes the `pipeline_group` panel

**Type** QtView

See also:

* cmp.pipelines.diffusion.diffusion.DiffusionPipeline

**check_input (layout, gui=True)**
Method that checks if inputs of the diffusion pipeline are available in the datasets.

**Parameters**

- **layout** (bids.BIDSLayout) – BIDSLayout object used to query
- **gui** (bool) – If True, display message in GUI

**Returns** valid_inputs – True in all inputs of the anatomical pipeline are available

**Return type** bool

**cmp.bidsappmanager.pipelines.functional package**

**Submodules**

**cmp.bidsappmanager.pipelines.functional.eeg module**

EEG pipeline Class definition

**cmp.bidsappmanager.pipelines.functional.fMRI module**

Functional pipeline UI Class definition.

```python
class cmp.bidsappmanager.pipelines.functional.fMRI.fMRIPipelineUI (project_info)
    Bases: cmp.pipelines.functional.fMRI.fMRIPipeline

    Class that extends the fMRIPipeline with graphical components.
```

**preprocessing**
Button to open the window for configuration or quality inspection of the preprocessing stage depending on the `view_mode`
**Type** traits.ui.Button

**registration**

Button to open the window for configuration or quality inspection of the registration stage depending on the view_mode

**Type** traits.ui.Button

**functionalMRI**

Button to open the window for configuration or quality inspection of the extra preprocessing stage stage depending on the view_mode

**Type** traits.ui.Button

**connectome**

Button to open the window for configuration or quality inspection of the connectome stage depending on the view_mode

**Type** traits.ui.Button

**view_mode**

Variable used to control the display of either (1) the configuration or (2) the quality inspection of stage of the pipeline

**Type** ['config_view', 'inspect_outputs_view']

**pipeline_group**

Panel defining the layout of the buttons of the stages with corresponding images

**Type** traitsUI panel

**traits_view**

QtView that includes the pipeline_group panel

**Type** QtView

**Check also:**

cmp.pipelines.functional.fMRI.fMRIPipeline

**check_input** *(layout, gui=True)*

Method that checks if inputs of the fMRI pipeline are available in the datasets.

**Parameters**

- **layout** *(bids.BIDSLayout)* – BIDSLayout object used to query
- **gui** *(bool)* – If True, display message in GUI

**Returns** valid_inputs – True in all inputs of the fMRI pipeline are available

**Return type** bool

**cmp.bidsappmanager.stages package**

**Subpackages**

**cmp.bidsappmanager.stages.connectome package**

**Submodules**
**cmp.bidsappmanager.stages.connectome.connectome module**

Definition of structural connectome config and stage UI classes.

```python
class cmp.bidsappmanager.stages.connectome.connectome.ConnectomeConfigUI
    Bases: cmp.stages.connectome.connectome.ConnectomeConfig

    Class that extends the ConnectomeConfig with graphical components.

    output_types
        A list of output_types. Valid output_types are 'gPickle', 'mat', 'cff', 'graphml'
        Type list of string

    connectivity_metrics
        A list of connectivity metrics to stored. Valid connectivity_metrics are 'Fiber number', 'Fiber length', 'Fiber density', 'Fiber proportion', 'Normalized fiber density', 'ADC', 'gFA'
        Type list of string

    traits_view
        TraitsUI view that displays the Attributes of this class
        Type traits.ui.View

See also:
    cmp.stages.connectome.connectome.ConnectomeConfig
```

```python
class cmp.bidsappmanager.stages.connectome.connectome.ConnectomeStageUI(bids_dir, output_dir)
    Bases: cmp.stages.connectome.connectome.ConnectomeStage

    Class that extends the ConnectomeStage with graphical components.

    log_visualization
        If True, display with a log transformation
        Type traits.Bool

    circular_layout
        If True, display the connectivity matrix using a circular layout
        Type traits.Bool

    inspect_output_button
        Button that displays the selected connectivity matrix in the graphical component for quality inspection
        Type traits.ui.Button

    inspect_outputs_view
        TraitsUI view that displays the quality inspection window of this stage
        Type traits.ui.View

    config_view
        TraitsUI view that displays the configuration window of this stage
        Type traits.ui.View

See also:
    cmp.stages.connectome.connectome.ConnectomeStage
```
cmp.bidsappmanager.stages.connectome.fmri_connectome module

Definition of functional connectome config and stage UI classes.

class cmp.bidsappmanager.stages.connectome.fmri_connectome.ConnectomeConfigUI
   Bases: cmp.stages.connectome.fmri_connectome.ConnectomeConfig

   Class that extends the ConnectomeConfig with graphical components.

   output_types
      A list of output_types. Valid output_types are ‘gPickle’, ‘mat’, ‘cff’, ‘graphml’
      Type list of string

   traits_view
      TraitsUI view that displays the Attributes of this class
      Type traits.ui.View

   See also:
      cmp.stages.connectome.fmri_connectome.ConnectomeConfig

class cmp.bidsappmanager.stages.connectome.fmri_connectome.ConnectomeStageUI(bids_dir, output_dir)
   Bases: cmp.stages.connectome.fmri_connectome.ConnectomeStage

   Class that extends the ConnectomeStage with graphical components.

   log_visualization
      If True, display with a log transformation
      Type traits.Bool

   circular_layout
      If True, display the connectivity matrix using a circular layout
      Type traits.Bool

   inspect_output_button
      Button that displays the selected connectivity matrix in the graphical component for quality inspection
      Type traits.ui.Button

   inspect_outputs_view
      TraitsUI view that displays the quality inspection window of this stage
      Type traits.ui.View

   config_view
      TraitsUI view that displays the configuration window of this stage
      Type traits.ui.View

   See also:
      cmp.stages.connectome.fmri_connectome.ConnectomeStage
cmp.bidsappmanager.stages.diffusion package

Submodules

cmp.bidsappmanager.stages.diffusion.diffusion module

Definition of diffusion reconstruction and tracking config and stage UI classes.

class cmp.bidsappmanager.stages.diffusion.diffusion.DiffusionConfigUI
    Bases: cmp.stages.diffusion.diffusion.DiffusionConfig

    Class that extends the DiffusionConfig with graphical components.

    It includes the graphical components defining the configuration of the diffusion reconstruction and tractography sub-stages.

    traits_view
        TraitsUI view that displays the Diffusion Stage Parameter Attributes of this class

        Type  traits.ui.View

    See also:

cmp.stages.diffusion.diffusion.DiffusionConfig

class cmp.bidsappmanager.stages.diffusion.diffusion.DiffusionStageUI(bids_dir, output_dir)
    Bases: cmp.stages.diffusion.diffusion.DiffusionStage

    Class that extends the DiffusionStage with graphical components.

    inspect_output_button
        Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)

        Type  traits.ui.Button

    inspect_outputs_view
        TraitsUI view that displays the quality inspection window of this stage

        Type  traits.ui.View

    config_view
        TraitsUI view that displays the configuration window of this stage

        Type  traits.ui.View

    See also:

cmp.stages.diffusion.diffusion.DiffusionStage
**cmp.bidsappmanager.stages.diffusion.reconstruction module**

Definition of diffusion reconstruction config UI classes.

```python
class cmp.bidsappmanager.stages.diffusion.reconstruction.Dipy_recon_configUI
    Bases: cmp.stages.diffusion.reconstruction.Dipy_recon_config
    
    Class that extends the Dipy_recon_config with graphical components.

    flip_table_axis
        List of axis to flip in the gradient table. Valid values are ‘x’, ‘y’, ‘z’
        Type list of string

    traits_view
        TraitsUI view that displays the attributes of this class, e.g. the parameters for diffusion reconstruction using Dipy
        Type traits.ui.View

See also:
    cmp.stages.diffusion.reconstruction.Dipy_recon_config
```

```python
class cmp.bidsappmanager.stages.diffusion.reconstruction.MRtrix_recon_configUI
    Bases: cmp.stages.diffusion.reconstruction.MRtrix_recon_config
    
    Class that extends the MRtrix_recon_config with graphical components.

    flip_table_axis
        List of axis to flip in the gradient table. Valid values are ‘x’, ‘y’, ‘z’
        Type list of string

    traits_view
        TraitsUI view that displays the attributes of this class, e.g. the parameters for diffusion reconstruction using MRtrix
        Type traits.ui.View

See also:
    cmp.stages.diffusion.reconstruction.MRtrix_recon_config
```

**cmp.bidsappmanager.stages.diffusion.tracking module**

Definition of diffusion tracking config UI classes.

```python
class cmp.bidsappmanager.stages.diffusion.tracking.Dipy_tracking_configUI
    Bases: cmp.stages.diffusion.tracking.Dipy_tracking_config
    
    Class that extends the Dipy_tracking_config with graphical components.

    traits_view
        TraitsUI view that displays the attributes of this class, e.g. the parameters for diffusion tractography using Dipy
        Type traits.ui.View

See also:
    cmp.stages.diffusion.tracking.Dipy_tracking_config
```
class cmp.bidsappmanager.stages.diffusion.tracking.MRtrix_tracking_configUI

Bases: cmp.stages.diffusion.tracking.MRtrix_tracking_config

Class that extends the MRtrix_tracking_config with graphical components.

traits_view

TraitsUI view that displays the attributes of this class, e.g. the parameters for tractography using MRtrix

    Type traits.ui.View

See also:

cmp.stages.diffusion.reconstruction.MRtrix_tracking_config

cmp.bidsappmanager.stages.functional package

Submodules

cmp.bidsappmanager.stages.functional.functionalMRI module

Definition of extra preprocessing of functional MRI (post-registration) config and stage UI classes.

class cmp.bidsappmanager.stages.functional.functionalMRI.FunctionalMRIConfigUI

Bases: cmp.stages.functional.functionalMRI.FunctionalMRIConfig

Class that extends the FunctionalMRIConfig with graphical components.

traits_view

TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage

    Type traits.ui.View

See also:

cmp.stages.functional.functionalMRI.FunctionalMRIConfig

class cmp.bidsappmanager.stages.functional.functionalMRI.FunctionalMRIStageUI (bids_dir, output_dir)

Bases: cmp.stages.functional.functionalMRI.FunctionalMRIStage

Class that extends the FunctionalMRIStage with graphical components.

inspect_output_button

Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)

    Type traits.ui.Button

inspect_outputs_view

TraitsUI view that displays the quality inspection window of this stage

    Type traits.ui.View

config_view

TraitsUI view that displays the configuration window of this stage

    Type traits.ui.View

See also:

cmp.stages.functional.functionalMRI.FunctionalMRIStage
cmp.bidsappmanager.stages.parcellation package

Submodules

cmp.bidsappmanager.stages.parcellation.parcellation module

Definition of parcellation config and stage UI classes.

class cmp.bidsappmanager.stages.parcellation.parcellation.ParcellationConfigUI
Bases: cmp.stages.parcellation.parcellation.ParcellationConfig

Class that extends the ParcellationConfig with graphical components.

traits_view
    TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage
    Type traits.ui.View

See also:
cmp.stages.parcellation.parcellation.ParcellationConfig

class cmp.bidsappmanager.stages.parcellation.parcellation.ParcellationStageUI(pipeline_mode, bids_dir, output_dir)
Bases: cmp.stages.parcellation.parcellation.ParcellationStage

Class that extends the ParcellationStage with graphical components.

inspect_output_button
    Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)
    Type traits.ui.Button

inspect_outputs_view
    TraitsUI view that displays the quality inspection window of this stage
    Type traits.ui.View

config_view
    TraitsUI view that displays the configuration window of this stage
    Type traits.ui.View

See also:
cmp.stages.parcellation.parcellation.ParcellationStage

cmp.bidsappmanager.stages.preprocessing package

Submodules

cmp.bidsappmanager.stages.preprocessing.fmri_preprocessing module

Definition of fMRI preprocessing config and stage UI classes.
class cmp.bidsappmanager.stages.preprocessing.fmri_preprocessing.PreprocessingConfigUI
Bases: cmp.stages.preprocessing.fmri_preprocessing.PreprocessingConfig
Class that extends the (functional) PreprocessingConfig with graphical components.

traits_view
  TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage
  
  Type traits.ui.View

See also:
  cmp.stages.preprocessing.fmri_preprocessing.PreprocessingConfig

class cmp.bidsappmanager.stages.preprocessing.fmri_preprocessing.PreprocessingStageUI(bids_dir, output_dir)
Bases: cmp.stages.preprocessing.fmri_preprocessing.PreprocessingStage
Class that extends the (functional) PreprocessingStage with graphical components.

inspect_output_button
  Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)
  
  Type traits.ui.Button

inspect_outputs_view
  TraitsUI view that displays the quality inspection window of this stage
  
  Type traits.ui.View

cfg_view
  TraitsUI view that displays the configuration window of this stage
  
  Type traits.ui.View

See also:
  cmp.stages.preprocessing.fmri_preprocessing.PreprocessingStage

cmp.bidsappmanager.stages.preprocessing.preprocessing module
Definition of diffusion preprocessing config and stage UI classes.

class cmp.bidsappmanager.stages.preprocessing.preprocessing.PreprocessingConfigUI
Bases: cmp.stages.preprocessing.preprocessing.PreprocessingConfig
Class that extends the (diffusion) PreprocessingConfig with graphical components.

traits_view
  TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage
  
  Type traits.ui.View

See also:
  cmp.stages.preprocessing.preprocessing.PreprocessingConfig

class cmp.bidsappmanager.stages.preprocessing.preprocessing.PreprocessingStageUI(bids_dir, output_dir)
Bases: cmp.stages.preprocessing.preprocessing.PreprocessingStage
Class that extends the (diffusion) PreprocessingStage with graphical components.
**inspect_output_button**

Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)

**Type** traits.ui.Button

**inspect_outputs_view**

TraitsUI view that displays the quality inspection window of this stage

**Type** traits.ui.View

**config_view**

TraitsUI view that displays the configuration window of this stage

**Type** traits.ui.View

See also:

cmp.stages.preprocessing.preprocessing.PreprocessingStage

**cmp.bidsappmanager.stages.registration package**

**Submodules**

**cmp.bidsappmanager.stagesregistration.registration module**

Definition of registration config and stage UI classes.

**class** cmp.bidsappmanager.stagesregistration.registration.RegistrationConfigUI

**Bases:** cmp.stages.registration.registration.RegistrationConfig

Class that extends the RegistrationConfig with graphical components.

**traits_view**

TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage

**Type** traits.ui.View

See also:

cmp.stages.registration.registration.RegistrationConfig

**class** cmp.bidsappmanager.stagesregistration.registration.RegistrationStageUI(pipeline_mode,

| fs_subjects_dir=
| fs_subject_id=
| bids_dir=
| output_dir="")

**Bases:** cmp.stages.registration.registration.RegistrationStage

Class that extends the RegistrationStage with graphical components.

**inspect_output_button**

Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)

**Type** traits.ui.Button

**inspect_outputs_view**

TraitsUI view that displays the quality inspection window of this stage

**Type** traits.ui.View
config_view
    TraitsUI view that displays the configuration window of this stage
    
    Type  traits.ui.View

See also:
    cmp.stages.registration.registration.RegistrationStage

cmp.bidsappmanager.stages.segmentation package

Submodules

cmp.bidsappmanager.stages.segmentation.segmentation module

Definition of segmentation config and stage UI classes.

class  cmp.bidsappmanager.stages.segmentation.segmentation.SegmentationConfigUI
    Bases: cmp.stages.segmentation.segmentation.SegmentationConfig

    Class that extends the SegmentationConfig with graphical components.

    traits_view
        TraitsUI view that displays the attributes of this class, e.g. the parameters for the stage
        
        Type  traits.ui.View

    See also:
        cmp.stages.segmentation.segmentation.SegmentationConfig

class  cmp.bidsappmanager.stages.segmentation.segmentation.SegmentationStageUI(bids_dir, output_dir)
    Bases: cmp.stages.segmentation.segmentation.SegmentationStage

    Class that extends the SegmentationStage with graphical components.

    inspect_output_button
        Button that displays the selected output in an appropriate viewer (present only in the window for quality inspection)
        
        Type  traits.ui.Button

    inspect_outputs_view
        TraitsUI view that displays the quality inspection window of this stage
        
        Type  traits.ui.View

    config_view
        TraitsUI view that displays the configuration window of this stage
        
        Type  traits.ui.View

    See also:
        cmp.stages.segmentation.segmentation.SegmentationStage
5.6.2 cmtklib package

Subpackages

cmtklib.bids package

Submodules

cmtklib.bids.utils module

This module provides CMTK Utility functions to handle BIDS datasets.

cmtklib.bids.utils.write_derivative_description(bids_dir, deriv_dir, pipeline_name)
Write a dataset_description.json in each type of CMP derivatives.

Parameters

• bids_dir (string) – BIDS root directory
• deriv_dir (string) – Output/derivatives directory
• pipeline_name (string) – Type of derivatives (['cmp', 'freesurfer', 'nipype'])

cmtklib.interfaces package

Submodules

cmtklib.interfaces.afni module

The AFNI module provides Nipype interfaces for the AFNI toolbox missing in nipype or modified.

Bandpass

Link to code

Bases: nipype.interfaces.afni.base.AFNICommand

Wrapped executable: 3dBandpass.

Program to lowpass and/or highpass each voxel time series in a dataset.

Calls the 3dBandpass tool from AFNI, offering more/different options than Fourier

For complete details, see the 3dBandpass Documentation.
Examples

```python
>>> from nipype.interfaces import afni as afni
>>> from nipype.testing import example_data
>>> bandpass = afni.Bandpass()
>>> bandpass.inputs.in_file = example_data('functional.nii')
>>> bandpass.inputs.highpass = 0.005
>>> bandpass.inputs.lowpass = 0.1
>>> res = bandpass.run()
```

**highpass** [a float] Highpass. Maps to a command-line argument: `%f` (position: -3).

**in_file** [a pathlike object or string representing an existing file] Input file to 3dBandpass. Maps to a command-line argument: `%s` (position: -1).

**lowpass** [a float] Lowpass. Maps to a command-line argument: `%f` (position: -2).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**automask** [a boolean] Create a mask from the input dataset. Maps to a command-line argument: `-automask`.

**blur** [a float]

- **Blur (inside the mask only) with a filter** width (FWHM) of ‘fff’ millimeters.
  Maps to a command-line argument: `-blur %f`.

**despike** [a boolean]

- **Despike each time series before other processing.**
  - ++ Hopefully, you don’t actually need to do this, which is why it is optional.
  - Maps to a command-line argument: `-despike`.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: `{}`)

**localPV** [a float]

- **Replace each vector by the local Principal Vector** (AKA first singular vector) from a neighborhood of radius ‘rrr’ millimeters.
  - ++ Note that the PV time series is L2 normalized. ++ This option is mostly for Bob Cox to have fun with.
  - Maps to a command-line argument: `-localPV %f`.

**mask** [a pathlike object or string representing an existing file] Mask file. Maps to a command-line argument: `-mask %s` (position: 2).

**nfft** [an integer] Set the FFT length [must be a legal value]. Maps to a command-line argument: `-nfft %d`.

**no_detrend** [a boolean]

- **Skip the quadratic detrending of the input that occurs before the FFT-based bandpassing.**
  - ++ You would only want to do this if the dataset had been detrended already in some other program.
  - Maps to a command-line argument: `-nodetrend`.
**normalize** [a boolean]

Make all output time series have L2 norm = 1 ++ i.e., sum of squares = 1.

Maps to a command-line argument: --norm.

**notrans** [a boolean]

Don’t check for initial positive transients in the data: ++ The test is a little slow, so skipping it is OK, if you KNOW the data time series are transient-free.

Maps to a command-line argument: --notrans.

**num_threads** [an integer] Set number of threads. (Nipype default value: 1)

**orthogonalize_dset** [a pathlike object or string representing an existing file]

Orthogonalize each voxel to the corresponding voxel time series in dataset ‘fset’, which must have the same spatial and temporal grid structure as the main input dataset. ++ At present, only one ‘-dsort’ option is allowed.

Maps to a command-line argument: --dsort %s.

**orthogonalize_file** [a list of items which are a pathlike object or string representing an existing file]

Also orthogonalize input to columns in f.1D ++ Multiple ‘-ort’ options are allowed.

Maps to a command-line argument: --ort %s.

**out_file** [a pathlike object or string representing a file] Output file from 3dBandpass. Maps to a command-line argument: --prefix %s (position: 1).

**outputtype** ['NIFTI' or 'AFNI' or 'NIFTI_GZ'] AFNI output filetype.

**tr** [a float] Set time step (TR) in sec [default=from dataset header]. Maps to a command-line argument: --dt %f.

**out_file** [a pathlike object or string representing an existing file] Output file.

---

**Despike**

**Link to code**

Bases: nipype.interfaces.afni.base.AFNICommand

Wrapped executable: 3dDespike.

Removes ‘spikes’ from the 3D+time input dataset.

It calls the 3dDespike tool from AFNI.

For complete details, see the 3dDespike Documentation.
Examples

```python
>>> from nipype.interfaces import afni
>>> despike = afni.Despike()
>>> despike.inputs.in_file = 'functional.nii'
>>> despike.cmdline
'3dDespike -prefix functional_despike functional.nii'
>>> res = despike.run()
```

**in_file** [a pathlike object or string representing an existing file] Input file to 3dDespike. Maps to a command-line argument: `%s` (position: -1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: `{}`)

**num_threads** [an integer] Set number of threads. (Nipype default value: 1)

**out_file** [a pathlike object or string representing a file] Output image file name. Maps to a command-line argument: `-prefix %s`.

**outputtype** ['NIFTI' or 'AFNI' or 'NIFTI_GZ'] AFNI output filetype.

**out_file** [a pathlike object or string representing an existing file] Output file.

cmtklib.interfaces.ants module

The ANTs module provides Nipype interfaces for the ANTs registration toolbox missing in nipype or modified.

**MultipleANTsApplyTransforms**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply linear and deformable transforms estimated by ANTS to a list of images.

It calls the `antsApplyTransform` on a series of images.

Examples

```python
>>> apply_tf = MultipleANTsApplyTransforms()
>>> apply_tf.inputs.input_images = ['path/to/sub-01_atlas-L2018_desc-scale1_dseg.nii.gz', 'path/to/sub-01_atlas-L2018_desc-scale2_dseg.nii.gz', 'path/to/sub-01_atlas-L2018_desc-scale3_dseg.nii.gz', 'path/to/sub-01_atlas-L2018_desc-scale4_dseg.nii.gz', 'path/to/sub-01_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> apply_tf.inputs.transforms = ['path/to/final1Warp.nii.gz', 'path/to/final0GenericAffine.mat']
>>> apply_tf.inputs.reference_image = File(mandatory=True, exists=True)
```
reference_image : a filename or object implementing the os.PathLike interface
transforms : a list of items which are a filename or object implementing the os.PathLike interface

Transform files: will be applied in reverse order. For example, the last specified transform will be applied first.

default_value : a float
input_images : a list of items which are a filename or object implementing the os.PathLike interface
interpolation : 'Linear' or 'NearestNeighbor' or 'CosineWindowedSinc' or 'Welch-WindowedSinc' or 'HammingWindowedSinc' or 'LanczosWindowedSinc' or 'MultiLabel' or 'Gaussian' or 'BSpline'

(Nipype default value: Linear)

out_postfix : [a string] (Nipype default value: _transformed)
output_images : a list of items which are a filename or object implementing the os.PathLike interface

**cmtklib.interfaces.camino module**

The Camino module provides Nipype interfaces for Camino functions missing in nipype or modified.

**DTLUTGen**

**Link to code**

Bases: nipype.interfaces.base.core.StdOutCommandLine

Wrapped executable: dtlutgen.

Calibrates the PDFs for PICo probabilistic tractography.

This program needs to be run once for every acquisition scheme. It outputs a lookup table that is used by the dtpicoparams program to find PICo PDF parameters for an image. The default single tensor LUT contains parameters of the Bingham distribution and is generated by supplying a scheme file and an estimated signal to noise in white matter regions of the (q=0) image. The default inversion is linear (inversion index 1).

Advanced users can control several options, including the extent and resolution of the LUT, the inversion index, and the type of PDF. See dtlutgen(1) for details.

**Example**

```python
>>> import cmtklib.interfaces.camino as cmon
>>> dtl = cmon.DTLUTGen()
>>> dtl.inputs.snr = 16
>>> dtl.inputs.scheme_file = 'A.scheme'
>>> dtl.run()
```

**scheme_file** [a pathlike object or string representing a file] The scheme file of the images to be processed using this LUT. Maps to a command-line argument: -schemefile %s (position: 2).
acg [a boolean] Compute a LUT for the ACG PDF. Maps to a command-line argument: -acg.

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

bingham [a boolean] Compute a LUT for the Bingham PDF. This is the default. Maps to a command-line argument: -bingham.

cross [a float] The angle in degrees between the principal directions of the two tensors. Maps to a command-line argument: -cross %d.

environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) 

frange [a list of from 2 to 2 items which are a float] Index to two-tensor LUTs. This is the fractional anisotropy of the two tensors. The default is 0.3 to 0.94. Maps to a command-line argument: -frange %s (position: 1).

inversion [an integer] Index of the inversion to use. The default is 1 (linear single tensor inversion). Maps to a command-line argument: -inversion %d.

lrange [a list of from 2 to 2 items which are a float] Index to one-tensor LUTs. This is the ratio L1/L3 and L2 / L3. The LUT is square, with half the values calculated (because L2 / L3 cannot be less than L1 / L3 by definition). The minimum must be >= 1. For comparison, a ratio L1 / L3 = 10 with L2 / L3 = 1 corresponds to an FA of 0.891, and L1 / L3 = 15 with L2 / L3 = 1 corresponds to an FA of 0.929. The default range is 1 to 10. Maps to a command-line argument: -lrange %s (position: 1).

out_file [a pathlike object or string representing a file] Maps to a command-line argument: > %s (position: -1).

samples [an integer] The number of synthetic measurements to generate at each point in the LUT. The default is 2000. Maps to a command-line argument: -samples %d.

snr [a float] The signal to noise ratio of the unweighted (q = 0) measurements. This should match the SNR (in white matter) of the images that the LUTs are used with. Maps to a command-line argument: -snr %d.

step [a float] Distance between points in the LUT. For example, if lrange is 1 to 10 and the step is 0.1, LUT entries will be computed at L1 / L3 = 1, 1.1, 1.2 ... 10.0 and at L2 / L3 = 1.0, 1.1 ... L1 / L3. For single tensor LUTs, the default step is 0.2, for two-tensor LUTs it is 0.02. Maps to a command-line argument: -step %d.

trace [a float] Trace of the diffusion tensor(s) used in the test function in the LUT generation. The default is 2100E-12 m^2 s^-1. Maps to a command-line argument: -trace %f.

watson [a boolean] Compute a LUT for the Watson PDF. Maps to a command-line argument: -watson.

dtLUT [a pathlike object or string representing an existing file] Lookup Table.

**PicoPDFs**

Link to code

Bases: nipype.interfaces.base.core.StdOutCommandLine

Wrapped executable: picopdfs.

Constructs a spherical PDF in each voxel for probabilistic tractography.
Example

```python
>>> import cmtklib.interfaces.camino as cmon
>>> pdf = cmon.PicoPDFs()
>>> pdf.inputs.inputmodel = 'dt'
>>> pdf.inputs.luts = 'lut_file'
>>> pdf.inputs.in_file = 'voxel-order_data.Bfloat'
>>> pdf.run()
```

**in_file** [a pathlike object or string representing an existing file] Voxel-order data filename. Maps to a command-line argument: `< %s (position: 1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**directmap** [a boolean]

Only applicable when using `pds` as the `inputmodel` Use direct mapping between the eigenvalues and the distribution parameters instead of the log of the eigenvalues.

Maps to a command-line argument: `--directmap`.

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: `{}`)

**inputmodel** ['dt' or 'multitensor' or 'pds'] Input model type. Maps to a command-line argument: `--inputmodel %s` (position: 2). (Nipype default value: `dt`)

**luts** [a list of items which are a pathlike object or string representing an existing file] Files containing the lookup tables. For tensor data, one lut must be specified for each type of inversion used in the image (one-tensor, two-tensor, three-tensor). For `pds`, the number of LUTs must match `-numpds` (it is acceptable to use the same LUT several times - see example, above). These LUTs may be generated with `dtlutgen`. Maps to a command-line argument: `--luts %s` (position: 3).

**maxcomponents** [an integer] The maximum number of tensor components in a voxel (default 2) for multitensor data. Currently, only the default is supported, but future releases may allow the input of three-tensor data using this option. Maps to a command-line argument: `--maxcomponents %d`.

**numpds** [an integer] The maximum number of PDs in a voxel (default 3) for PD data. This option determines the size of the input and output voxels. This means that the data file may be large enough to accommodate three or more PDs, but does not mean that any of the voxels are classified as containing three or more PDs. Maps to a command-line argument: `--numpds %d`.

**out_file** [a pathlike object or string representing a file] Maps to a command-line argument: `> %s` (position: -1).

**pdf** ['watson' or 'bingham' or 'acg']

Specifies the PDF to use. There are three choices: watson - The Watson distribution. This distribution is rotationally symmetric. bingham - The Bingham distribution, which allows elliptical probability density contours. acg - The Angular Central Gaussian distribution, which also allows elliptical probability density contours.

Maps to a command-line argument: `--pdf %s` (position: 4). (Nipype default value: watson)

**pdfs** [a pathlike object or string representing an existing file] Path/name of 4D volume in voxel order.
Voxel2Image

Link to code

Bases: nipype.interfaces.base.core.StdOutCommandLine

Wrapped executable: voxel2image.

Converts voxel order image to NIFTI / MHA files.

Converts voxel-order data to scanner-order data in a supported image format.

Examples

```python
>>> import cmtklib.interfaces.camino as cmon
>>> vox2img = cmon.Voxel2Image()
>>> vox2img.inputs.in_file = 'fa.img'
>>> vox2img.run()
```

**header_file** [a pathlike object or string representing an existing file] File with desired format. Maps to a command-line argument: `--header %s` (position: 2).

**in_file** [a pathlike object or string representing an existing file] Image in camino format. Maps to a command-line argument: `--inputfile %s` (position: 1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**components** [an integer] Number of components in inputfile. Maps to a command-line argument: `--components %d`.

**environ** [a dictionary with keys which are a bytes or None or a value of class `str` and with values which are a bytes or None or a value of class `str`] Environment variables. (Nipype default value: `{}`)

**gzip** [a boolean] Compress output image. Maps to a command-line argument: `--gzip`.

**out_file** [a pathlike object or string representing a file] Maps to a command-line argument: `>%s` (position: -1).

**out_type** ["float" or 'char' or 'short' or 'int' or 'long' or 'double"] “i.e. Bfloat”. Can be “char”, “short”, “int”, “long”, “float” or “double”. Maps to a command-line argument: `--outputdatatype %s`.

(Nipype default value: `float`)

**output_root** [a string] Maps to a command-line argument: `--outputroot %s` (position: -1). (Nipype default value: `converted`)

**image_file** [a pathlike object or string representing an existing file] Path/name to converted file.

cmtklib.interfaces.camino2trackvis module

Provides interfaces for functions provided by Camino-Tackvis missing in nipype or modified.
Camino2Trackvis

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: camino_to_trackvis.

Wraps camino_to_trackvis from Camino-Trackvis.

Convert files from camino .Bfloat format to trackvis .trk format.

Example

```python
>>> import cmtklib.interfaces.camino2trackvis as cam2trk
>>> c2t = cam2trk.Camino2Trackvis()
>>> c2t.inputs.in_file = 'data.Bfloat'
>>> c2t.inputs.out_file = 'streamlines.trk'
>>> c2t.inputs.min_length = 30
>>> c2t.inputs.data_dims = [128, 104, 64]
>>> c2t.inputs.voxel_dims = [2.0, 2.0, 2.0]
>>> c2t.inputs.voxel_order = 'LAS'
>>> c2t.run()
```

**in_file** [a pathlike object or string representing an existing file] The input .Bfloat (camino) file. Maps to a command-line argument: -i %s (position: 1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**data_dims** [a list of from 3 to 3 items which are an integer] Three comma-separated integers giving the number of voxels along each dimension of the source scans. Maps to a command-line argument: -d %s (position: 4).

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {})

**min_length** [a float] The minimum length of tracts to output. Maps to a command-line argument: -l %d (position: 3).

**nifti_file** [a pathlike object or string representing an existing file] Read coordinate system from a NIfTI file. Maps to a command-line argument: --nifti %s (position: 7).

**out_file** [a pathlike object or string representing a file] The filename to which to write the .trk (trackvis) file. Maps to a command-line argument: -o %s (position: 2).

**phys_coords** [a boolean] Treat the input tract points as physical coordinates (relevant for the updated camino track command). Maps to a command-line argument: --phys-coords (position: 8).

**voxel_dims** [a list of from 3 to 3 items which are a float] Three comma-separated numbers giving the size of each voxel in mm. Maps to a command-line argument: -x %s (position: 5).

**voxel_order** [a pathlike object or string representing a file] Set the order in which various directions were stored. Specify with three letters consisting of one each from the pairs LR, AP, and SI. These stand for Left-Right, Anterior-Posterior, and Superior-Inferior. Whichever is specified in each position will be the direction of increasing order. Read coordinate system from a NIfTI file. Maps to a command-line argument: --voxel-order %s (position: 6).

**trackvis** [a pathlike object or string representing an existing file] The filename to which to write the .trk (trackvis) file.
The Diffusion Toolkit module provides Nipype interfaces for the Diffusion Toolkit missing in nipype or modified.

**DTIRecon**

Link to code

Bases: nipype.interfaces.base.CommandLine

Wrapped executable: dti_recon.

Use dti_recon to generate tensors and other maps.

---

**Note:** Not used anymore by CMP3

**DWI** [a pathlike object or string representing an existing file] Input diffusion volume. Maps to a command-line argument: `%s` (position: 1).

**gradient_matrix** [a pathlike object or string representing an existing file] Specify gradient matrix to use. required. Maps to a command-line argument: `-gm %s` (position: 3).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**b0_threshold** [a float]

Program will use b0 image with the given threshold to mask out high background of fa/adc maps. by default it will calculate threshold automatically. but if it failed, you need to set it manually.

Maps to a command-line argument: `-b0_th`.

**b_value** [an integer] Set b value or maximum b value for multi-bvalue data. default is 1000. Maps to a command-line argument: `-b %d`.

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: `{ }`)

**image_orientation_vectors** [a list of from 6 to 6 items which are a float]

Specify image orientation vectors. if just one argument given, will treat it as filename and read the orientation vectors from the file. if 6 arguments are given, will treat them as 6 float numbers and construct the 1st and 2nd vector and calculate the 3rd one automatically. this information will be used to determine image orientation, as well as to adjust gradient vectors with oblique angle when.

Maps to a command-line argument: `-iop %f`.

**multiple_b_values** [a boolean]

If ‘MultiBvalue’ is ‘true’ or 1, it will either use the bvalues specified as the 4th component of each gradient vector, or use max b value scaled by the magnitude of the vector.

Maps to a command-line argument: `%d` (position: 4).

**n_averages** [an integer] Number of averages. Maps to a command-line argument: `-nex %s`.

**number_of_b0** [an integer]

Number of repeated b0 images on top. default is 1. the program assumes b0 images are on top.

Maps to a command-line argument: `-b0 %d`. 
oblique_correction [a boolean]

When oblique angle(s) applied, some SIEMENS dti protocols do not adjust gradient accordingly, thus it requires adjustment for correct diffusion tensor calculation.

Maps to a command-line argument: -oc.

out_prefix [a string] Output file prefix. Maps to a command-line argument: %s (position: 2). (Nipype default value: dti)

output_type ['nii' or 'analyze' or 'ni1' or 'nii.gz'] Output file type. Maps to a command-line argument: -ot %s. (Nipype default value: nii)

ADC : a pathlike object or string representing an existing file
B0 : a pathlike object or string representing an existing file
DWI : a pathlike object or string representing an existing file
FA : a pathlike object or string representing an existing file
L1 : a pathlike object or string representing an existing file
L2 : a pathlike object or string representing an existing file
L3 : a pathlike object or string representing an existing file
FA_color : a pathlike object or string representing an existing file
V1 : a pathlike object or string representing an existing file
V2 : a pathlike object or string representing an existing file
V3 : a pathlike object or string representing an existing file
tenensor : a pathlike object or string representing an existing file

DiffUnpack

DiffUnpack

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: diff_unpack.

Use diff_unpack to convert dicom files to multiple formats.

Examples

>>> convert = DiffUnpack()
>>> convert.inputs.input_dicom = '/path/to/sub-01_dwi.dcm'
>>> convert.inputs.out_prefix = 'output'
>>> convert.inputs.output_type = 'nii.gz'
>>> convert.run()

input_dicom [a pathlike object or string representing an existing file] Input dicom file. Maps to a command-line argument: %s (position: 1).

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

environ [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {})

out_prefix [a string] Output file prefix. Maps to a command-line argument: %s (position: 2). (Nipype default value: output)

output_type ['nii' or 'analyze' or 'ni1' or 'nii.gz'] Output file type. Maps to a command-line argument: -ot %s. (Nipype default value: nii)

split [a boolean]

Instead of saving everything in one big multi-timepoint 4D image, split it into separate files, one timepoint per file.

Maps to a command-line argument: -split.
**converted_files**  [a list of items which are any value] Converted files.

**HARDIMat**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: hardi_mat.

Use hardi_mat to calculate a reconstruction matrix from a gradient table.

**Examples**

```python
>>> hardi_mat = HARDIMat()
>>> hardi_mat.inputs.bvecs = 'sub-01_dwi.bvec'
>>> hardi_mat.inputs.bvals = 'sub-01_dwi.bval'
>>> hardi_mat.inputs.gradient_table = 'sub-01_grad.txt'
>>> hardi_mat.inputs.out_file = 'recon_mat.dat'
>>> hardi_mat.inputs.order = 8
>>> hardi_mat.inputs.reference_file = 'sub-01_dwi.nii.gz'
>>> hardi_mat.run()
```

**args**  [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**bvals**  [a pathlike object or string representing an existing file] B values file.

**bvecs**  [a pathlike object or string representing an existing file] B vectors file. Maps to a command-line argument: %s (position: 1).

**environ**  [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})  

**gradient_table**  [a pathlike object or string representing an existing file] Input gradient table. Maps to a command-line argument: %s (position: 1).

**image_info**  [a pathlike object or string representing an existing file]

   Specify image information file. the image info file is generated from original dicom image by diff_unpack program and contains image orientation and other information needed for reconstruction and tracking. by default will look into the image folder for .info file.

   Maps to a command-line argument: --info %s.

**image_orientation_vectors**  [a list of from 6 to 6 items which are a float]

   Specify image orientation vectors. if just one argument given, will treat it as filename and read the orientation vectors from the file. if 6 arguments are given, will treat them as 6 float numbers and construct the 1st and 2nd vector and calculate the 3rd one automatically. This information will be used to determine image orientation, as well as to adjust gradient vectors with oblique angle when.

   Maps to a command-line argument: --iop %f.

**oblique_correction**  [a boolean]

   When oblique angle(s) applied, some SIEMENS dti protocols do not adjust gradient accordingly, thus it requires adjustment for correct diffusion tensor calculation.

   Maps to a command-line argument: --oc.
odf_file [a pathlike object or string representing an existing file]

**Filename that contains the reconstruction points on a HEMI-sphere.** use the pre-set 181 points by default.

Maps to a command-line argument: \(-\text{odf } \%s\).

order [an integer]

**Maximum order of spherical harmonics. must be even number. default** is 4.

out_file [a pathlike object or string representing a file] Output matrix file. Maps to a command-line argument: \(\%s\) (position: 2). (Nipype default value: \(\text{recon\_mat.dat}\))

reference_file [a pathlike object or string representing an existing file]

**Provide a dicom or nifti image as the reference for the program to** figure out the image orientation information. if no such info was found in the given image header, the next 5 options \(-\text{info}, \text{etc.},\) will be used if provided. if image orientation info can be found in the given reference, all other 5 image orientation options will be IGNORED.

Maps to a command-line argument: \(-\text{ref } \%s\).

out_file [a pathlike object or string representing an existing file] Output matrix file.

cmtklib.interfaces.dipy module

The Dipy module provides Nipype interfaces to the algorithms in dipy.

CSD

Link to code

Bases: nipype.interfaces.dipy.base.DipyDiffusionInterface

Uses CSD [Tournier2007] to generate the fODF of DWIs.

The interface uses **dipy**, as explained in dipy’s CSD example.

References

Example

```
>>> from cmtklib.interfaces.dipy import CSD
>>> csd = CSD()
>>> csd.inputs.in_file = '4d_dwi.nii'
>>> csd.inputs.in_bval = 'bvals'
>>> csd.inputs.in_bvec = 'bvecs'
>>> res = csd.run()
```

in_bval [a pathlike object or string representing an existing file] Input b-values table.

in_bvec [a pathlike object or string representing an existing file] Input b-vectors table.

in_file [a pathlike object or string representing an existing file] Input diffusion data.

b0_thres [an integer] B0 threshold. (Nipype default value: 700)

fa_thresh [a float] FA threshold used for response estimation. (Nipype default value: 0.7)
**CMP3 Documentation, Release v3.0.0-RC4**

**in_mask** [a pathlike object or string representing an existing file] Input mask in which compute tensors.

**out_fods** [a pathlike object or string representing a file] FODFs output file name.

**out_prefix** [a string] Output prefix for file names.

**out_shm_coeff** [a pathlike object or string representing a file] Spherical Harmonics Coefficients output file name.

**response** [a pathlike object or string representing an existing file] Single fiber estimated response.

**save_fods** [a boolean] Save fODFs in file. (Nipype default value: True)

**save_shm_coeff** [a boolean] Save Spherical Harmonics Coefficients in file. (Nipype default value: True)

**sh_order** [an integer] Maximal spherical harmonics order. (Nipype default value: 8)

**tracking_processing_tool** : 'mrtrix' or 'dipy'

**model** [a pathlike object or string representing a file] Python pickled object of the CSD model fitted.

**out_fods** [a pathlike object or string representing a file] FODFs output file name.

**out_shm_coeff** [a pathlike object or string representing a file] Spherical Harmonics Coefficients output file name.

**DTIEstimateResponseSH**

Link to code

Bases: nipype.interfaces.dipy.base.DipyDiffusionInterface

Uses dipy to compute the single fiber response to be used by spherical deconvolution methods.

The single fiber response is computed in a similar way to MRTrix’s command `estimate_response`.

**Example**

```python
>>> from cmtklib.interfaces.dipy import DTIEstimateResponseSH
>>> dti = DTIEstimateResponseSH()
>>> dti.inputs.in_file = '4d_dwi.nii'
>>> dti.inputs.in_bval = 'bvals'
>>> dti.inputs.in_bvec = 'bvecs'
>>> res = dti.run()
```

**in_bval** [a pathlike object or string representing an existing file] Input b-values table.

**in_bvec** [a pathlike object or string representing an existing file] Input b-vectors table.

**in_file** [a pathlike object or string representing an existing file] Input diffusion data.

**auto** [a boolean] Use the auto_response estimator from dipy. Mutually exclusive with inputs: recursive.

**b0_thres** [an integer] B0 threshold. (Nipype default value: 700)

**fa_thresh** [a float] FA threshold. (Nipype default value: 0.7)

**in_mask** [a pathlike object or string representing an existing file] Input mask in which we find single fibers.
out_mask [a pathlike object or string representing a file] Computed wm mask. (Nipype default value: wm_mask.nii.gz)

out_prefix [a string] Output prefix for file names.

recursive [a boolean] Use the recursive response estimator from dipy. Mutually exclusive with inputs: auto.

response [a pathlike object or string representing a file] The output response file. (Nipype default value: response.txt)

roi_radius [an integer] ROI radius to be used in auto_response. (Nipype default value: 10)

ad_file : a pathlike object or string representing an existing file dti_model : a pathlike object or string representing an existing file

DTI model object.

fa_file : a pathlike object or string representing an existing file md_file : a pathlike object or string representing an existing file out_mask : a pathlike object or string representing an existing file

Output wm mask.

rd_file : a pathlike object or string representing an existing file response : a pathlike object or string representing an existing file

The response file.

DirectionGetterTractography

Link to code

Bases: nipype.interfaces.dipy.base.DipyBaseInterface
Streamline tractography using Dipy Deterministic Maximum Direction Getter.

Example

```python
>>> from cmtklib.interfaces import dipy as ndp
>>> track = ndp.DirectionGetterTractography()
>>> track.inputs.in_file = '4d_dwi.nii'
>>> track.inputs.in_model = 'model.pklz'
>>> track.inputs.tracking_mask = 'dilated_wm_mask.nii'
>>> res = track.run()
```

fa_thresh [a float] FA threshold to build the tissue classifier. (Nipype default value: 0.2)
in_fa [a pathlike object or string representing an existing file] Input FA.
in_file [a pathlike object or string representing an existing file] Input diffusion data.
in_model [a pathlike object or string representing an existing file] Input f/d-ODF model extracted from.
max_angle [a float] Maximum angle. (Nipype default value: 25.0)
multiprocess [a boolean] Use multiprocessing. (Nipype default value: True)
num_seeds [an integer] Desired number of tracks in tractography. (Nipype default value: 10000)
save_seeds [a boolean] Save seeding voxels coordinates. (Nipype default value: False)
seed_mask  [a list of items which are a pathlike object or string representing an existing file] ROI files registered to diffusion space.

step_size  [a float] Step size. (Nipype default value: 0.5)

tracking_mask  [a pathlike object or string representing an existing file] Input mask within which perform tracking.

algo  ['deterministic' or 'probabilistic'] Use either deterministic maximum (default) or probabilistic direction getter tractography. (Nipype default value: deterministic)

fod_file  [a pathlike object or string representing an existing file] Input fod file (if SHORE).

gmwmi_file  [a pathlike object or string representing an existing file] Input Gray Matter / White Matter interface image.

in_partial_volume_files  [a list of items which are a pathlike object or string representing an existing file] Partial volume estimation result files (required if performing ACT).

out_prefix  [a string] Output prefix for file names.

recon_model  ['CSD' or 'SHORE'] Use either fODFs from CSD (default) or SHORE models. (Nipype default value: CSD)

recon_order  [an integer] Spherical harmonics order.

seed_density  [a float] Density of seeds. (Nipype default value: 1)

seed_from_gmwmi  [a boolean] Seed from the Gray Matter / White Matter interface.

use_act  [a boolean] Use FAST for partial volume estimation and Anatomically-Constrained Tractography (ACT) tissue classifier.

out_seeds  [a pathlike object or string representing a file] File containing the (N,3) voxel coordinates used in seeding.

streamlines  [a pathlike object or string representing a file] Numpy array of streamlines.

tracks  [a pathlike object or string representing a file] TrackVis file containing extracted streamlines.

tracks2  [a pathlike object or string representing a file] TrackVis file containing extracted streamlines.

tracks3  [a pathlike object or string representing a file] TrackVis file containing extracted streamlines.

MAPMRI

Link to code

Bases: nipype.interfaces.dipy.base.DipyDiffusionInterface

Computes the MAP MRI model.

for reference on the settings
Example

```python
>>> from cmtklib.interfaces.dipy import MAPMRI
>>> mapmri = MAPMRI()
>>> mapmri.inputs.in_file = '4d_dwi.nii'
>>> mapmri.inputs.in_bval = 'bvals'
>>> mapmri.inputs.in_bvec = 'bvecs'
>>> res = mapmri.run()
```

big_delta [a float] Small data for gradient table.

in_bval [a pathlike object or string representing an existing file] Input b-values table.

in_bvec [a pathlike object or string representing an existing file] Input b-vectors table.

in_file [a pathlike object or string representing an existing file] Input diffusion data.

small_delta [a float] Small data for gradient table.

b0_thres [an integer] B0 threshold. (Nipype default value: 700)

laplacian_regularization [a boolean] Apply laplacian regularization. (Nipype default value: True)

laplacian_weighting [a float] Regularization weight. (Nipype default value: 0.05)

out_prefix [a string] Output prefix for file names.

positivity_constraint [a boolean] Apply positivity constraint. (Nipype default value: True)

radial_order [an integer] Maximal spherical harmonics order. (Nipype default value: 8)

model [a pathlike object or string representing a file] Python pickled object of the MAP-MRI model fitted.

msd_file [a pathlike object or string representing a file] Msd output file name.

ng_file [a pathlike object or string representing a file] Ng output file name.

ng_para_file [a pathlike object or string representing a file] Ng parallel output file name.

ng_perp_file [a pathlike object or string representing a file] Ng perpendicular output file name.

qiv_file [a pathlike object or string representing a file] Qiv output file name.

rtap_file [a pathlike object or string representing a file] Rtap output file name.

rtop_file [a pathlike object or string representing a file] Rtop output file name.

rtpp_file [a pathlike object or string representing a file] Rtpp output file name.

**SHORE**

Link to code

Bases: nipype.interfaces.dipy.base.DipyDiffusionInterface

Uses SHORE [Merlet13] to generate the fODF of DWIs.

The interface uses dipy, as explained in dipy's SHORE example.
References

“Continuous diffusion signal, EAP and ODF estimation via Compressive Sensing in diffusion MRI”

Example

```python
>>> from cmtklib.interfaces.dipy import SHORE
>>> asm = SHORE(radial_order=6, zeta=700, lambda_n=1e-8, lambda_l=1e-8)
>>> asm.inputs.in_file = '4d_dwi.nii'
>>> asm.inputs.in_bval = 'bvals'
>>> asm.inputs.in_bvec = 'bvecs'
>>> res = asm.run()
```

- `in_bval` [a pathlike object or string representing an existing file] Input b-values table.
- `in_bvec` [a pathlike object or string representing an existing file] Input b-vectors table.
- `in_file` [a pathlike object or string representing an existing file] Input diffusion data.
- `b0_thres` [an integer] B0 threshold. (Nipype default value: 700)
- `constrain_e0` [a boolean] Constrain the optimization such that $E(0) = 1$. (Nipype default value: False)
- `in_mask` [a pathlike object or string representing an existing file] Input mask in which compute SHORE solution.
- `lambda_l` [a float] Angular regularisation constant. (Nipype default value: 1e-08)
- `lambda_n` [a float] Radial regularisation constant. (Nipype default value: 1e-08)
- `out_prefix` [a string] Output prefix for file names.
- `positive_constraint` [a boolean] Constrain the optimization such that $E(0) = 1$. (Nipype default value: False)
- `radial_order` [an integer] Even number that represents the order of the basis. (Nipype default value: 6)
- `response` [a pathlike object or string representing an existing file] Single fiber estimated response.
- `tau` [a float] Diffusion time. By default the value that makes $q$ equal to the square root of the b-value.
- `tracking_processing_tool` : 'mrtrix' or 'dipy'
- `zeta` : an integer

Scale factor. (Nipype default value: 700)

- `GFA` [a pathlike object or string representing a file] Generalized Fractional Anisotropy output file name.
- `MSD` [a pathlike object or string representing a file] Mean Square Displacement output file name.
- `RTOP` [a pathlike object or string representing a file] Return To Origin Probability output file name.
- `dodf` [a pathlike object or string representing a file] Fiber Orientation Distribution Function output file name.
- `fodf` [a pathlike object or string representing a file] Fiber Orientation Distribution Function output file name.
- `model` [a pathlike object or string representing a file] Python pickled object of the SHORE model fitted.
TensorInformedEudXTractography

Link to code

Bases: nipype.interfaces.dipy.base.DipyBaseInterface

Streamline tractography using Dipy Deterministic Maximum Direction Getter.

Example

```python
>>> from cmtklib.interfaces import dipy as ndp
>>> track = ndp.TensorInformedEudXTractography()
>>> track.inputs.in_file = '4d_dwi.nii'
>>> track.inputs.in_model = 'model.pklz'
>>> track.inputs.tracking_mask = 'dilated_wm_mask.nii'
>>> res = track.run()
```

fa_thresh [a float] FA threshold to build the tissue classifier. (Nipype default value: 0.2)

in_fa [a pathlike object or string representing an existing file] Input FA.

in_file [a pathlike object or string representing an existing file] Input diffusion data.

in_model [a pathlike object or string representing an existing file] Input Tensor model extracted from.

max_angle [a float] Maximum angle. (Nipype default value: 25.0)

multiprocess [a boolean] Use multiprocessing. (Nipype default value: True)

num_seeds [an integer] Desired number of tracks in tractography. (Nipype default value: 10000)

save_seeds [a boolean] Save seeding voxels coordinates. (Nipype default value: False)

seed_mask [a list of items which are a pathlike object or string representing an existing file] ROI files registered to diffusion space.

step_size [a float] Step size. (Nipype default value: 0.5)

tracking_mask [a pathlike object or string representing an existing file] Input mask within which perform tracking.

out_prefix [a string] Output prefix for file names.

out_seeds [a pathlike object or string representing a file] File containing the (N,3) voxel coordinates used in seeding.

tracks [a pathlike object or string representing a file] TrackVis file containing extracted streamlines.

cmtklib.interfaces.freesurfer module

The FreeSurfer module provides Nipype interfaces for Freesurfer tools missing in nipype or modified.
BBRegister

Link to code

Bases: nipype.interfaces.freesurfer.base.FSCommand

Wrapped executable: bbregister.

Use FreeSurfer bbregister to register a volume to the Freesurfer anatomical.

This program performs within-subject, cross-modal registration using a boundary-based cost function. The registration is constrained to be 6 DOF (rigid). It is required that you have an anatomical scan of the subject that has already been recon-all-ed using freesurfer.

Examples

```python
>>> from cmtklib.interfaces.freesurfer import BBRegister
>>> bbreg = BBRegister(subject_id='me',
                    source_file='structural.nii',
                    init='header',
                    contrast_type='t2')
>>> bbreg.run()
```

**contrast_type** ['t1' or 't2' or 'dti'] Contrast type of image. Maps to a command-line argument: --%s.

**init** ['spm' or 'fsl' or 'header'] Initialize registration spm, fsl, header. Maps to a command-line argument:
--init-%s. Mutually exclusive with inputs: init_reg_file.

**init_reg_file** [a pathlike object or string representing an existing file] Existing registration file. Mutually exclusive with inputs: init.

**source_file** [a pathlike object or string representing a file] Source file to be registered. Maps to a command-line argument:
--mov %s.

**subject_id** [a string] Freesurfer subject id. Maps to a command-line argument: --s %s.

**args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {})
**tkregister2**

**Link to code**

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: tkregister2.

Performs image co-registration using Freesurfer tkregister2.

**Examples**

```python
def fslreg_out [a string] FSL-Style registration output matrix. Maps to a command-line argument:--fslregout %s.
```

```python
def in_file [a pathlike object or string representing a file] Movable volume. Maps to a command-line argument:--mov %s.
```

```python
def reg_out [a string] Input/output registration file. Maps to a command-line argument:--reg %s.
```

```python
def target_file [a pathlike object or string representing a file] Target volume. Maps to a command-line argument:--targ %s.
```

```python
def args [a string] Additional parameters to the command. Maps to a command-line argument: %s.
```

```python
def environ [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {}) (Nipype default value: {}) (Nipype default value: {}) (Nipype default value: {}) (Nipype default value: {})
```

```python
def noedit [a boolean] Do not open edit window (exit) - for conversions. Maps to a command-line argument:--noedit.
```

```python
def regheader [a boolean] Compute registration from headers. Maps to a command-line argument:--regheader.
```

---

5.6. Packages and modules
subject_id  [a string] Set subject id. Maps to a command-line argument: --s %s.

subjects_dir  [a pathlike object or string representing an existing directory] Use dir as SUBJECTS_DIR. Maps to a command-line argument: --sd %s.

fsreregout_file  [a pathlike object or string representing a file] Resulting FSL-Style registration matrix.

regout_file  [a pathlike object or string representing a file] Resulting registration file.

copyBrainMaskToFreesurfer

Link to code

Bases: nipype.interfaces.io.IOBase

Copy a custom brain mask in the freesurfer subject mri/ directory.

It replaces the brainmask files generated by Freesurfer recon-all in order to re-run recon-all with a custom brain mask.

Examples

```python
>>> from cmtklib.interfaces.freesurfer import copyBrainMaskToFreesurfer
>>> copy_mask_fs = copyBrainMaskToFreesurfer()
>>> copy_mask_fs.inputs.in_file = 'sub-01_desc-brain_mask.nii.gz'
>>> copy_mask_fs.inputs.subject_dir = '/path/to/output_dir/freesurfer/sub-01'
>>> copy_mask_fs.run()
```

in_file : a pathlike object or string representing an existing file
subject_dir : a pathlike object or string representing an existing directory

out_brainmask_file : a pathlike object or string representing an existing file
out_brainmaskauto_file : a pathlike object or string representing an existing file

copyFileToFreesurfer

Link to code

Bases: nipype.interfaces.io.IOBase

Copy a file to an output specified.

Note: Note used.

in_file : a pathlike object or string representing an existing file
out_file : a pathlike object or string representing a file

out_file : a pathlike object or string representing an existing file
**cmtklib.interfaces.fsl module**

The FSL module provides Nipype interfaces for FSL functions missing in Nipype or modified.

**ApplymultipleWarp**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply a deformation field estimated by FSL fnirt to a list of images.

**Example**

```python
>>> from cmtklib.interfaces import fsl
>>> apply_warp = fsl.ApplymultipleWarp()
>>> apply_warp.inputs.in_files = ['/path/to/sub-01_atlas-L2018_desc-scale1_dseg.nii.gz',
                                 '/path/to/sub-01_atlas-L2018_desc-scale2_dseg.nii.gz',
                                 '/path/to/sub-01_atlas-L2018_desc-scale3_dseg.nii.gz',
                                 '/path/to/sub-01_atlas-L2018_desc-scale4_dseg.nii.gz',
                                 '/path/to/sub-01_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> apply_warp.inputs.field_file = '/path/to/fnirt_deformation.nii.gz'
>>> apply_warp.inputs.ref_file = '/path/to/sub-01_meanBOLD.nii.gz'
>>> apply_warp.run()
```

**field_file** [a pathlike object or string representing an existing file] Deformation field.

**ref_file** [a pathlike object or string representing an existing file] Reference image used for target space.

**in_files** [a list of items which are a pathlike object or string representing an existing file] Files to be registered.

**interp** ['nn' or 'trilinear' or 'sinc' or 'spline'] Interpolation method. Maps to a command-line argument: `--interp=%s` (position: -2).

**out_files** [a list of items which are a pathlike object or string representing a file] Warped files.

**ApplymultipleXfm**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply an XFM transform estimated by FSL flirt to a list of images.
Example

```python
>>> from cmtklib.interfaces import fsl
>>> apply_xfm = fsl.ApplymultipleXfm
>>> apply_xfm.inputs.in_files = ['./path/to/sub-01_atlas-L2018_desc-scale1_dseg.nii.gz',
       './path/to/sub-01_atlas-L2018_desc-scale2_dseg.nii.gz',
       './path/to/sub-01_atlas-L2018_desc-scale3_dseg.nii.gz',
       './path/to/sub-01_atlas-L2018_desc-scale4_dseg.nii.gz',
       './path/to/sub-01_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> apply_xfm.inputs.xfm_file = './path/to/flirt_transform.xfm'
>>> apply_xfm.inputs.reference = './path/to/sub-01_meanBOLD.nii.gz'
>>> apply_xfm.run()
```

**reference**  [a pathlike object or string representing an existing file] Reference image used for target space.

**xfm_file**  [a pathlike object or string representing an existing file] Transform file.

**in_files**  [a list of items which are a pathlike object or string representing an existing file] Files to be registered.

**out_files**  [a list of items which are a pathlike object or string representing a file] Transformed files.

### BinaryThreshold

**Link to code**

Bases: nipype.interfaces.fsl.base.FSLCommand

Wrapped executable: fslmaths.

Use fslmaths to apply a threshold to an image in a variety of ways.

**Examples**

```python
>>> from cmtklib.interfaces.fsl import BinaryThreshold
>>> thresh = BinaryThreshold()
>>> thresh.inputs.in_file = './path/to/probseg.nii.gz'
>>> thresh.inputs.thresh = 0.5
>>> thresh.inputs.out_file = './path/to/output_binseg.nii.gz'
>>> thresh.run()
```

**in_file**  [a pathlike object or string representing an existing file] Image to operate on. Maps to a command-line argument: %s (position: 2).

**out_file**  [a pathlike object or string representing a file] Image to write. Maps to a command-line argument: %s (position: 5).

**thresh**  [a float] Threshold value. Maps to a command-line argument: -thr %s (position: 3).

**args**  [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**binarize**  [a boolean] Maps to a command-line argument: -bin (position: 4).
environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) output_type ['NIFTI' or 'NIFTI_PAIR' or 'NIFTI_GZ' or 'NIFTI_PAIR_GZ'] FSL output type. out_file [a pathlike object or string representing an existing file] Image written after calculations.

CreateAcqpFile

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Create an acquisition Acqp file for FSL eddy.

Note: This value can be extracted from dMRI data acquired on Siemens scanner

Examples

```python
>>> from cmtklib.interfaces.fsl import CreateAcqpFile
>>> create_acqp = CreateAcqpFile()
>>> create_acqp.inputs.total_readout = 0.28
>>> create_acqp.run()
```

total_readout : a float

acqp : a pathlike object or string representing an existing file

CreateIndexFile

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Create an index file for FSL eddy from a mrtrix diffusion gradient table.

Examples

```python
>>> from cmtklib.interfaces.fsl import CreateIndexFile
>>> create_index = CreateIndexFile()
>>> create_index.inputs.in_grad_mrtrix = 'grad.txt'
>>> create_index.run()
```

in_grad_mrtrix [a pathlike object or string representing an existing file] Input DWI gradient table in MRTrix format.

index : a pathlike object or string representing an existing file
Eddy

Link to code

Bases: nipype.interfaces.fsl.base.FSLCommand

Wrapped executable: eddy.

Performs eddy current distortion correction using FSL eddy.

Example

```python
def main():
    from cmtklib.interfaces import fsl
    eddyc = fsl.Eddy(in_file='diffusion.nii',
                     bvecs='diffusion.bvecs',
                     bvals='diffusion.bvals',
                     out_file='diffusion_eddyc.nii')
    eddyc.run()

if __name__ == '__main__':
    main()
```

**acqp** [a pathlike object or string representing an existing file] File containing acquisition parameters. Maps to a command-line argument: `--acqp=%s` (position: 3).

**bvals** [a pathlike object or string representing an existing file] File containing the b-values for all volumes in `--imain`. Maps to a command-line argument: `--bvals=%s` (position: 5).

**bvecs** [a pathlike object or string representing an existing file] File containing the b-vectors for all volumes in `--imain`. Maps to a command-line argument: `--bvecs=%s` (position: 4).

**in_file** [a pathlike object or string representing an existing file] File containing all the images to estimate distortions for. Maps to a command-line argument: `--imain=%s` (position: 0).

**index** [a pathlike object or string representing an existing file] File containing indices for all volumes in `--imain` into `--acqp` and `--topup`. Maps to a command-line argument: `--index=%s` (position: 2).

**mask** [a pathlike object or string representing an existing file] Mask to indicate brain. Maps to a command-line argument: `--mask=%s` (position: 1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: `{}`)

**out_file** [a pathlike object or string representing a file] Basename for output. Maps to a command-line argument: `--out=%s` (position: 6).

**output_type** ['NIFTI' or 'NIFTI_PAIR' or 'NIFTI_GZ' or 'NIFTI_PAIR_GZ'] FSL output type.


**bvecs_rotated** [a pathlike object or string representing an existing file] Path/name of rotated DWI gradient bvecs file.

**eddy_corrected** [a pathlike object or string representing an existing file] Path/name of 4D eddy corrected DWI file.
EddyOpenMP

Link to code

Bases: nipype.interfaces.fsl.base.FSLCommand

Wrapped executable: eddy_openmp.

Performs eddy current distortion correction using FSL eddy_openmp.

Example

```python
>>> from cmtklib.interfaces import fsl
>>> eddyc = fsl.EddyOpenMP(in_file='diffusion.nii',
                          bvecs='diffusion.bvecs',
                          bvals='diffusion.bvals',
                          out_file="diffusion_eddyc.nii")
>>> eddyc.run()
```

- `acqp` [a pathlike object or string representing an existing file] File containing acquisition parameters. Maps to a command-line argument: `--acqp=%s` (position: 3).
- `bvals` [a pathlike object or string representing an existing file] File containing the b-values for all volumes in `--imain`. Maps to a command-line argument: `--bvals=%s` (position: 5).
- `bvecs` [a pathlike object or string representing an existing file] File containing the b-vectors for all volumes in `--imain`. Maps to a command-line argument: `--bvecs=%s` (position: 4).
- `in_file` [a pathlike object or string representing an existing file] File containing all the images to estimate distortions for. Maps to a command-line argument: `--imain=%s` (position: 0).
- `index` [a pathlike object or string representing an existing file] File containing indices for all volumes in `--imain` into `--acqp` and `--topup`. Maps to a command-line argument: `--index=%s` (position: 2).
- `mask` [a pathlike object or string representing an existing file] Mask to indicate brain. Maps to a command-line argument: `--mask=%s` (position: 1).
- `args` [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.
- `environ` [a dictionary with keys which are a bytes or None or a value of class `str` and with values which are a bytes or None or a value of class `str`] Environment variables. (Nipype default value: `{}`)
- `out_file` [a pathlike object or string representing a file] Basename for output. Maps to a command-line argument: `--out=%s` (position: 6).
- `output_type` ['NIFTI' or 'NIFTI_PAIR' or 'NIFTI_GZ' or 'NIFTI_PAIR_GZ'] FSL output type.
- `bvecs_rotated` [a pathlike object or string representing an existing file] Path/name of rotated DWI gradient bvecs file.
- `eddy_corrected` [a pathlike object or string representing an existing file] Path/name of 4D eddy corrected DWI file.
**FSLCreateHD**

**Link to code**

```
Bases: nipype.interfaces.base.core.CommandLine
Wrapped executable: fslcreatehd.
Calls the fslcreatehd command to create an image for space / dimension reference.
```

**Examples**

```python
from cmtklib.interfaces.fsl import FSLCreateHD
fsl_create = FSLCreateHD()
```

- **datatype** ['2' or '4' or '8' or '16' or '32' or '64'] Datatype values: 2=char, 4=short, 8=int, 16=float, 64=double. Maps to a command-line argument: %s (position: 5).
- **im_size** [a list of from 4 to 4 items which are an integer] Image size : xsize, ysize, zsize, tsize. Maps to a command-line argument: %s (position: 1).
- **origin** [a list of from 3 to 3 items which are an integer] Origin coordinates : xorig, yorig, zorig. Maps to a command-line argument: %s (position: 4).
- **out_filename** [a pathlike object or string representing a file]
  the output temp reference image created.
  Maps to a command-line argument: %s (position: 6).
- **tr** [an integer] <tr>. Maps to a command-line argument: %s (position: 3).
- **vox_size** [a list of from 3 to 3 items which are an integer] Voxel size : xvoxsize, yvoxsize, zvoxsize. Maps to a command-line argument: %s (position: 2).
- **args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.
- **environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {})
- **out_file** [a pathlike object or string representing an existing file] Path/name of the output reference image created.
MathsCommand

Link to code

Bases: nipype.interfaces.fsl.base.FSLCommand

Wrapped executable: fslmaths.

Calls the fslmaths command in a variety of ways.

Examples

```python
>>> from cmtklib.interfaces.fsl import MathsCommand
>>> fsl_maths = MathsCommand()
>>> fsl_maths.inputs.in_file = '/path/to/image_with_nans.nii.gz'
>>> fsl_maths.inputs.nan2zeros = True
>>> fsl_maths.inputs.out_file = '/path/to/image_with_no_nans.nii.gz'
>>> fsl_maths.run()
```

in_file [a pathlike object or string representing an existing file] Image to operate on. Maps to a command-line argument: %s (position: 2).

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

environ [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: {})

internal_datatype ['float' or 'char' or 'int' or 'short' or 'double' or 'input'] Datatype to use for calculations (default is float). Maps to a command-line argument: -dt %s (position: 1).

nan2zeros [a boolean] Change NaNs to zeros before doing anything. Maps to a command-line argument: -nan (position: 3).

out_file [a pathlike object or string representing a file] Image to write. Maps to a command-line argument: %s (position: -2).

output_datatype ['float' or 'char' or 'int' or 'short' or 'double' or 'input'] Datatype to use for output (default uses input type). Maps to a command-line argument: -odt %s (position: -1).

output_type ['NIFTI' or 'NIFTI_PAIR' or 'NIFTI_GZ' or 'NIFTI_PAIR_GZ'] FSL output type.

out_file [a pathlike object or string representing an existing file] Image written after calculations.

Orient

Link to code

Bases: nipype.interfaces.fsl.base.FSLCommand

Wrapped executable: fslorient.

Use fslorient to get/set orientation information from an image’s header.

Advanced tool that reports or sets the orientation information in a file. Note that only in NIfTI files can the orientation be changed - Analyze files are always treated as “radiological” (meaning that they could be simply rotated into the same alignment as the MNI152 standard images - equivalent to the appropriate sform or qform in a NIfTI file having a negative determinant).
Examples

```python
>>> from cmtklib.interfaces.fsl import Orient
>>> fsorient = Orient()
>>> fsorient.inputs.in_file = 'input_image.nii.gz'
>>> fsorient.inputs.force_radiological = True
>>> fsorient.inputs.out_file = 'output_image.nii.gz'
>>> fsorient.run()
```

**in_file** [a pathlike object or string representing an existing file] Input image. Maps to a command-line argument: `%s` (position: 2).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.


**environ** [a dictionary with keys which are a bytes or None or a value of class `str` and with values which are a bytes or None or a value of class `str`] Environment variables. (Nipype default value: `{ }`)


set_qformcode, set_qformcode, copy_sform2qform, copy_qform2sform, deleteorient, forceraiodical, forceneurological, swaporient.


output_type ['NIFTI' or 'NIFTI_PAIR' or 'NIFTI_GZ' or 'NIFTI_PAIR_GZ'] FSL output type.

set_qform [a list of from 16 to 16 items which are a float] <m11 m12 ... m44> sets the 16 elements of the qform matrix. Maps to a command-line argument: -setqform %f (position: 1). Mutually exclusive with inputs: getorient, get_sform, get_qform, set_sform, set_qform, get_sformcode, get_qformcode, set_sformcode, set_qformcode, copy_sform2qform, copy_qform2sform, deleteorient, forceraiodical, forceneurological, swaporient.


set_sform [a list of from 16 to 16 items which are a float] <m11 m12 ... m44> sets the 16 elements of the sform matrix. Maps to a command-line argument: -setsform %f (position: 1). Mutually exclusive with inputs: getorient, get_sform, get_qform, set_sform, set_qform, get_qformcode, set_sformcode, set_qformcode, copy_sform2qform, copy_qform2sform, deleteorient, forceraiodical, forceneurological, swaporient.


orient [a string] FSL left-right orientation.

out_file [a pathlike object or string representing an existing file] Image with modified orientation.

qform [a list of from 16 to 16 items which are a float] The 16 elements of the qform matrix.
**qformcode** [an integer] Qform integer code.

**sform** [a list of from 16 to 16 items which are a float] The 16 elements of the sform matrix.

**sformcode** [an integer] Sform integer code.

Orient.

```python
aggregate_outputs(runtime=None, needed_outputs=None)
```

Collate expected outputs and apply output traits validation.

---

**cmtklib.interfaces.misc module**

**ConcatOutputsAsTuple**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Concatenate 2 different output file as a Tuple of 2 files.

**Examples**

```python
>>> from cmtklib.interfaces.misc import ConcatOutputsAsTuple
>>> concat_outputs = ConcatOutputsAsTuple()
>>> concat_outputs.inputs.input1 = 'output_interface1.nii.gz'
>>> concat_outputs.inputs.input2 = 'output_interface2.nii.gz'
>>> concat_outputs.run()
```

- **input1**: a pathlike object or string representing an existing file
- **input2**: a pathlike object or string representing an existing file
- **out_tuple**: a tuple of the form: (a pathlike object or string representing an existing file, a pathlike object or string representing an existing file)

---

**ExtractHeaderVoxel2WorldMatrix**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Write in a text file the voxel-to-world transform matrix from the heaer of a Nifti image.

**Examples**

```python
>>> from cmtklib.interfaces.misc import ExtractHeaderVoxel2WorldMatrix
>>> extract_mat = ExtractHeaderVoxel2WorldMatrix()
>>> extract_mat.inputs.in_file = 'sub-01_T1w.nii.gz'
>>> extract_mat.run()
```

- **in_file** [a pathlike object or string representing an existing file] Input image file.
- **out_matrix** [a pathlike object or string representing an existing file] Output voxel to world affine transform file.
ExtractImageVoxelSizes

Bases: nipype.interfaces.base.core.BaseInterface

Returns a list of voxel sizes from an image.

Examples

```python
>>> from cmtklib.interfaces.misc import ExtractImageVoxelSizes
>>> extract_voxel_sizes = ExtractImageVoxelSizes()
>>> extract_voxel_sizes.inputs.in_file = 'sub-01_T1w.nii.gz'
>>> extract_voxel_sizes.run()
```

in_file : a pathlike object or string representing an existing file

voxel_sizes : a list of items which are any value

cmtklib.interfaces.mrtrix3 module

The MRTrix3 module provides Nipype interfaces for MRTrix3 tools missing in Nipype or modified.

ApplymultipleMRConvert

Bases: nipype.interfaces.base.core.BaseInterface

Apply `mrconvert` tool to multiple images.

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> mrc = mrt.ApplymultipleMRConvert()
>>> mrc.inputs.in_files = ['dwi_FA.mif','dwi_MD.mif']
>>> mrc.inputs.extension = 'nii'
>>> mrc.run()
```

extension ['mif' or 'nii' or 'float' or 'char' or 'short' or 'int' or 'long' or 'double'] “i.e. Bfloat”. Can be

“char”, “short”, “int”, “long”, “float” or “double”. (Nipype default value: mif)

in_files [a list of items which are a pathlike object or string representing an existing file] Files to be

registered.

output_datatype ['float32' or 'float32le' or 'float32be' or 'float64' or 'float64le' or 'float64be' or 'int64' or 'uint64' or 'uint64le' or 'uint64be' or 'int32' or 'uint32' or 'int32le' or 'uint32le' or 'int32be' or 'uint32be' or 'int16' or 'uint16' or 'uint16le' or 'uint16be' or 'int16e' or 'uint16e' or 'cfloat32' or 'cfloat32le' or 'cfloat32be' or 'cfloat64' or 'cfloat64le' or 'cfloat64be' or 'int8' or 'uint8' or 'bit'] Specify output image data type. Valid choices are: float32, float32le, float32be, float64, float64le, float64be, int64, uint64, int64le, uint64le, int64be, uint64be, int32, uint32, int32le, uint32le, int32be, uint32be, int16, uint16, int16le, uint16le, int16be, uint16be, cfloat32, cfloat32le, cfloat32be, cfloat64, cfloat64le, cfloat64be, int8, uint8, bit. Maps to a command-line argument: –datatype %s (position: 2).
**stride**  [a list of from 3 to 4 items which are an integer] Three to four comma-separated numbers specifying the strides of the output data in memory. The actual strides produced will depend on whether the output image format can support it. Maps to a command-line argument: \(-\text{stride} \, \%s\) (position: 3).

**converted_files**  [a list of items which are a pathlike object or string representing a file] Output files.

### ApplymultipleMRCrop

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply MRCrop to a list of images.

**Example**

```python
>>> from cmtklib.interfaces.mrtrix3 import ApplymultipleMRCrop
>>> multi_crop = ApplymultipleMRCrop()
>>> multi_crop.inputs.in_files = ['/sub-01_atlas-L2018_desc-scale1_dseg.nii.gz',
'...',
'...',
'...',
'...',
'...']
>>> multi_crop.inputs.template_image = 'sub-01_T1w.nii.gz'
>>> multi_crop.run()
```

See also:

cmtklib.interfaces.mrtrix3.MRCrop

template_image  [a pathlike object or string representing an existing file] Template image.
in_files  [a list of items which are a pathlike object or string representing an existing file] Files to be cropped.

**out_files**  [a list of items which are a pathlike object or string representing a file] Cropped files.

### ApplymultipleMRTransforms

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply MRTransform to a list of images.
Example

```python
>>> from cmtklib.interfaces.mrtrix3 import ApplymultipleMRTransforms
>>> multi_transform = ApplymultipleMRTransforms()
>>> multi_transform.inputs.in_files = ['./sub-01_atlas-L2018_desc-scale1_dseg.nii.gz',
'./sub-01_atlas-L2018_desc-scale2_dseg.nii.gz',
'./sub-01_atlas-L2018_desc-scale3_dseg.nii.gz',
'./sub-01_atlas-L2018_desc-scale4_dseg.nii.gz',
'./sub-01_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> multi_transform.inputs.template_image = 'sub-01_T1w.nii.gz'
>>> multi_transform.run()
```

See also:

- `cmtklib.interfaces.mrtrix3.MRTransform`
  - `template_image` [a pathlike object or string representing an existing file] Template image.
  - `in_files` [a list of items which are a pathlike object or string representing an existing file] Files to be transformed.
  - `out_files` [a list of items which are a pathlike object or string representing a file] Transformed files.

**ConstrainedSphericalDeconvolution**

Link to code

- Bases: `nipype.interfaces.base.core.CommandLine`
- Wrapped executable: `dwi2fod`

Perform non-negativity constrained spherical deconvolution using `dwi2fod`.

Note that this program makes use of implied symmetries in the diffusion profile. First, the fact the signal attenuation profile is real implies that it has conjugate symmetry, i.e. \( Y(l,-m) = Y(l,m)^* \) (where \(^*\) denotes the complex conjugate). Second, the diffusion profile should be antipodally symmetric (i.e. \( S(x) = S(-x) \)), implying that all odd \( l \) components should be zero. Therefore, this program only computes the even elements. Note that the spherical harmonics equations used here differ slightly from those conventionally used, in that the \((-1)^m\) factor has been omitted. This should be taken into account in all subsequent calculations. Each volume in the output image corresponds to a different spherical harmonic component, according to the following convention:

- [0] \( Y(0,0) \)
- [1] \( \text{Im} \{ Y(2,2) \} \)
- [2] \( \text{Im} \{ Y(2,1) \} \)
- [3] \( Y(2,0) \)
- [4] \( \text{Re} \{ Y(2,1) \} \)
- [5] \( \text{Re} \{ Y(2,2) \} \)
- [6] \( \text{Im} \{ Y(4,4) \} \)
- [7] \( \text{Im} \{ Y(4,3) \} \)
Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> csdeconv = mrt.ConstrainedSphericalDeconvolution()
>>> csdeconv.inputs.in_file = 'dwi.mif'
>>> csdeconv.inputs.encoding_file = 'encoding.txt'
>>> csdeconv.run()
```

**algorithm** ['csd'] Use CSD algorithm for FOD estimation. Maps to a command-line argument: `%s` (position: -4).

**in_file** [a pathlike object or string representing an existing file] Diffusion-weighted image. Maps to a command-line argument: `%s` (position: -3).

**response_file** [a pathlike object or string representing an existing file] The diffusion-weighted signal response function for a single fibre population (see EstimateResponse). Maps to a command-line argument: `%s` (position: -2).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**directions_file** [a pathlike object or string representing an existing file] A text file containing the [el az] pairs for the directions: Specify the directions over which to apply the non-negativity constraint (by default, the built-in 300 direction set is used). Maps to a command-line argument: `-directions %s` (position: -2).

**encoding_file** [a pathlike object or string representing an existing file] Gradient encoding, supplied as a 4xN text file with each line is in the format [ X Y Z b ], where [ X Y Z ] describe the direction of the applied gradient, and b gives the b-value in units (1000 s/mm^2). See FSL2MRTrix. Maps to a command-line argument: `-grad %s` (position: 1).

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: `{}`)

**filter_file** [a pathlike object or string representing an existing file] A text file containing the filtering coefficients for each even harmonic order. the linear frequency filtering parameters used for the initial linear spherical deconvolution step (default = [ 1 1 1 0 0 ]). Maps to a command-line argument: `-filter %s` (position: -2).

**iterations** [an integer] The maximum number of iterations to perform for each voxel (default = 50). Maps to a command-line argument: `-niter %s`.

**lambda_value** [a float] The regularisation parameter lambda that controls the strength of the constraint (default = 1.0). Maps to a command-line argument: `-norm_lambda %s`.

**mask_image** [a pathlike object or string representing an existing file] Only perform computation within the specified binary brain mask image. Maps to a command-line argument: `-mask %s` (position: 2).

**maximum_harmonic_order** [an integer] Set the maximum harmonic order for the output series. By default, the program will use the highest possible lmax given the number of diffusion-weighted images. Maps to a command-line argument: `-lmax %s`.

**out_filename** [a pathlike object or string representing a file] Output filename. Maps to a command-line argument: `%s` (position: -1).

**threshold_value** [a float] The threshold below which the amplitude of the FOD is assumed to be zero, expressed as a fraction of the mean value of the initial FOD (default = 0.1). Maps to a command-line argument: `-threshold %s`.

**spherical_harmonics_image** [a pathlike object or string representing an existing file] Spherical harmonics image.
**DWI2Tensor**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: dwi2tensor.

Converts diffusion-weighted images to tensor images using `dwi2tensor`.

### Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt

>>> dwi2tensor = mrt.DWI2Tensor()

>>> dwi2tensor.inputs.in_file = 'dwi.mif'

>>> dwi2tensor.inputs.encoding_file = 'encoding.txt'

>>> dwi2tensor.run()
```

**in_file** [a list of items which are any value] Diffusion-weighted images. Maps to a command-line argument: `%s` (position: -2).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**debug** [a boolean] Display debugging messages. Maps to a command-line argument: `-debug` (position: 1).

**encoding_file** [a pathlike object or string representing a file] Encoding file, supplied as a 4xN text file with each line in the format [ X Y Z b ], where [ X Y Z ] describe the direction of the applied gradient, and b gives the b-value in units (1000 s/mm²). See FSL2MRTRix(). Maps to a command-line argument: `-grad %s` (position: 2).

**environ** [a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str'] Environment variables. (Nipype default value: `{}`)

**ignore_slice_by_volume** [a list of from 2 to 2 items which are an integer] Requires two values (i.e. [34 1] for [Slice Volume]) Ignores the image slices specified when computing the tensor. Slice here means the z coordinate of the slice to be ignored. Maps to a command-line argument: `-ignoreslices %s` (position: 2).

**ignore_volumes** [a list of at least 1 items which are an integer] Requires two values (i.e. [2 5 6] for [Volumes]) Ignores the image volumes specified when computing the tensor. Maps to a command-line argument: `-ignorevolumes %s` (position: 2).

**in_mask_file** [a pathlike object or string representing an existing file] Input DWI mask. Maps to a command-line argument: `-mask %s` (position: -3).

**out_filename** [a pathlike object or string representing a file] Output tensor filename. Maps to a command-line argument: `%s` (position: -1).

**quiet** [a boolean] Do not display information messages or progress status. Maps to a command-line argument: `-quiet` (position: 1).

**tensor** [a pathlike object or string representing an existing file] Path/name of output diffusion tensor image.
**DWIBiasCorrect**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: dwibiascorrect.

Correct for bias field in diffusion MRI data using the dwibiascorrect tool.

**Example**

```python
>>> from cmtklib.interfaces.mrtrix3 import DWIBiasCorrect
>>> dwi_biascorr = DWIBiasCorrect()
>>> dwi_biascorr.inputs.in_file = 'sub-01_dwi.nii.gz'
>>> dwi_biascorr.inputs.use_ants = True
>>> dwi_biascorr.run()
```

in_file [a pathlike object or string representing an existing file] The input image series to be corrected. Maps to a command-line argument: %s (position: -2).

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.


environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) (position: 2).


mask [a pathlike object or string representing a file] Manually provide a mask image for bias field estimation (optional). Maps to a command-line argument: -mask %s (position: 2).

out_bias [a pathlike object or string representing a file] Output the estimated bias field. Maps to a command-line argument: -bias %s (position: 3).

out_file [a pathlike object or string representing an existing file] The output corrected image series. Maps to a command-line argument: %s (position: -1).

use_ants [a boolean] Use ANTS N4 to estimate the inhomogeneity field. Maps to a command-line argument: ants (position: 1). Mutually exclusive with inputs: use_ants, use_fsl.

use_fsl [a boolean] Use FSL FAST to estimate the inhomogeneity field. Maps to a command-line argument: fsl (position: 1). Mutually exclusive with inputs: use_ants, use_fsl.

out_bias [a pathlike object or string representing an existing file] Output estimated bias field.

out_file [a pathlike object or string representing an existing file] Output corrected DWI image.
DWIDenoise

Link to code

Bases: nipype.interfaces.base.CommandLine

Wrapped executable: dwidenoise.

Denoise diffusion MRI data using the dwidenoise tool.

Example

```python
>>> from cmtklib.interfaces.mrtrix3 import DWIDenoise
>>> dwi_denoise = DWIDenoise()
>>> dwi_denoise.inputs.in_file = 'sub-01_dwi.nii.gz'
>>> dwi_denoise.inputs.out_file = 'sub-01_desc-denoised_dwi.nii.gz'
>>> dwi_denoise.inputs.out_noisemap = 'sub-01_mod-dwi_noisemap.nii.gz'
>>> dwi_denoise.run()
```

in_file [a pathlike object or string representing an existing file] Input diffusion-weighted image filename. Maps to a command-line argument: %s (position: -2).

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.


environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) (Nipype default value: {}) (Nipype default value: {})

extent_window [a list of from 3 to 3 items which are a float] Three comma-separated numbers giving the window size of the denoising filter. Maps to a command-line argument: -extent %s (position: 2).


mask [a pathlike object or string representing a file] Only perform computation within the specified binary brain mask image. (optional). Maps to a command-line argument: -mask %s (position: 1).

out_file [a pathlike object or string representing a file] Output denoised DWI image filename. Maps to a command-line argument: %s (position: -1).

out_noisemap [a pathlike object or string representing a file] Output noise map filename. Maps to a command-line argument: -noise %s (position: 3).

out_file [a pathlike object or string representing an existing file] Output denoised DWI image.

out_noisemap [a pathlike object or string representing an existing file] Output noise map (if generated).
**Erode**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: maskfilter.

Erode (or dilates) a mask (i.e. binary) image using the `maskfilter` tool.

**Example**

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> erode = mrt.Erode()
>>> erode.inputs.in_file = 'mask.mif'
>>> erode.run()
```

- **in_file** [a pathlike object or string representing an existing file] Input mask image to be eroded. Maps to a command-line argument: `%s` (position: -3).
- **args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.
- **debug** [a boolean] Display debugging messages. Maps to a command-line argument: `-debug` (position: 1).
- **dilate** [a boolean] Perform dilation rather than erosion. Maps to a command-line argument: `-dilate` (position: 1).
- **environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: `{}`)
- **filtertype** [‘clean’ or ‘connect’ or ‘dilate’ or ‘erode’ or ‘median’] The type of filter to be applied (clean, connect, dilate, erode, median). Maps to a command-line argument: `%s` (position: -2).
- **number_of_passes** [an integer] The number of passes (default: 1). Maps to a command-line argument: `-npass %s`.
- **out_filename** [a pathlike object or string representing a file] Output image filename. Maps to a command-line argument: `%s` (position: -1).
- **quiet** [a boolean] Do not display information messages or progress status. Maps to a command-line argument: `-quiet` (position: 1).
- **out_file** [a pathlike object or string representing an existing file] The output image.

**EstimateResponseForSH**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: dwi2response.

Estimates the fibre response function for use in spherical deconvolution using `dwi2response`.
Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> estresp = mrt.EstimateResponseForSH()
>>> estresp.inputs.in_file = 'dwi.mif'
>>> estresp.inputs.mask_image = 'dwi_WMProb.mif'
>>> estresp.inputs.encoding_file = 'encoding.txt'
>>> estresp.run()
```

**encoding_file** [a pathlike object or string representing an existing file] Gradient encoding, supplied as a 4xN text file with each line is in the format [ X Y Z b ], where [ X Y Z ] describe the direction of the applied gradient, and b gives the b-value in units (1000 s/mm$^2$). See FSL2MRTRix. Maps to a command-line argument: `-grad %s` (position: -2).

**in_file** [a pathlike object or string representing an existing file] Diffusion-weighted images. Maps to a command-line argument: `%s` (position: 2).

**mask_image** [a pathlike object or string representing an existing file] Only perform computation within the specified binary brain mask image. Maps to a command-line argument: `-mask %s` (position: -1).

**algorithm** ['dhollander' or 'fa' or 'manual' or 'msmt_5tt' or 'tax' or 'tournier'] Select the algorithm to be used to derive the response function; additional details and options become available once an algorithm is nominated. Options are: dhollander, fa, manual, msmt_5tt, tax, tournier. Maps to a command-line argument: `%s` (position: 1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**debug** [a boolean] Display debugging messages. Maps to a command-line argument: `-debug`.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: `{}`)

**maximum_harmonic_order** [an integer] Set the maximum harmonic order for the output series. By default, the program will use the highest possible lmax given the number of diffusion-weighted images. Maps to a command-line argument: `-lmax %s` (position: -3).

**out_filename** [a pathlike object or string representing a file] Output filename. Maps to a command-line argument: `%s` (position: 3).

**quiet** [a boolean] Do not display information messages or progress status. Maps to a command-line argument: `-quiet`.

**response** [a pathlike object or string representing an existing file] Spherical harmonics image.

---

**ExtractFSLGrad**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: mrinfo.

Use mrinfo to extract FSL gradient.
Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> fsl_grad = mrt.ExtractFSLGrad()
>>> fsl_grad.inputs.in_file = 'sub-01_dwi.mif'
>>> fsl_grad.inputs.out_grad_fsl = ['sub-01_dwi.bvecs', 'sub-01_dwi.bvals']
>>> fsl_grad.run()
```

<table>
<thead>
<tr>
<th>in_file</th>
<th>[a pathlike object or string representing an existing file]</th>
<th>Input images to be read. Maps to a command-line argument: %s (position: -2).</th>
</tr>
</thead>
<tbody>
<tr>
<td>args</td>
<td>[a string]</td>
<td>Additional parameters to the command. Maps to a command-line argument: %s.</td>
</tr>
<tr>
<td>environ</td>
<td>[a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str']</td>
<td>Environment variables. (Nipype default value: {})</td>
</tr>
<tr>
<td>out_grad_fsl</td>
<td>[a tuple of the form: (a pathlike object or string representing a file, a pathlike object or string representing a file)]</td>
<td>Export the DWI gradient table to files in FSL (bvecs / bvals) format. Maps to a command-line argument: -export_grad_fsl %s %s.</td>
</tr>
<tr>
<td>out_grad_fsl</td>
<td>[a tuple of the form: (a pathlike object or string representing an existing file, a pathlike object or string representing an existing file)]</td>
<td>Outputs [bvecs, bvals] DW gradient scheme (FSL format) if set.</td>
</tr>
</tbody>
</table>

ExtractMRTrixGrad

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: mrinfo.

Use mrinfo to extract mrtrix gradient text file.

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> mrtrix_grad = mrt.ExtractMRTrixGrad()
>>> mrtrix_grad.inputs.in_file = 'sub-01_dwi.mif'
>>> mrtrix_grad.inputs.out_grad_mrtrix = 'sub-01_gradient.txt'
>>> mrtrix_grad.run()
```

<table>
<thead>
<tr>
<th>in_file</th>
<th>[a pathlike object or string representing an existing file]</th>
<th>Input images to be read. Maps to a command-line argument: %s (position: -2).</th>
</tr>
</thead>
<tbody>
<tr>
<td>args</td>
<td>[a string]</td>
<td>Additional parameters to the command. Maps to a command-line argument: %s.</td>
</tr>
<tr>
<td>environ</td>
<td>[a dictionary with keys which are a bytes or None or a value of class 'str' and with values which are a bytes or None or a value of class 'str']</td>
<td>Environment variables. (Nipype default value: {})</td>
</tr>
<tr>
<td>out_grad_mrtrix</td>
<td>[a pathlike object or string representing a file]</td>
<td>Export the DWI gradient table to file in Mrtrix format. Maps to a command-line argument: -export_grad_mrtrix %s.</td>
</tr>
<tr>
<td>out_grad_mrtrix</td>
<td>[a pathlike object or string representing a file]</td>
<td>Output Mrtrix gradient text file if set.</td>
</tr>
</tbody>
</table>
FilterTractogram

Link to code

Bases: MRTrix3Base

Wrapped executable: tcksift.

Spherical-deconvolution informed filtering of tractograms using tcksift [Smith2013SIFT].

References

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as cmp_mrt

>>> mrtrix_sift = cmp_mrt.FilterTractogram()

>>> mrtrix_sift.inputs.in_tracks = 'tractogram.tck'

>>> mrtrix_sift.inputs.in_fod = 'spherical_harmonics_image.nii.gz'

>>> mrtrix_sift.inputs.out_file = 'sift_tractogram.tck'

>>> mrtrix_sift.run()
```

in_fod [a pathlike object or string representing an existing file] Input image containing the spherical harmonics of the fibre orientation distributions. Maps to a command-line argument: %s (position: -2).

in_tracks [a pathlike object or string representing an existing file] Input track file in TCK format. Maps to a command-line argument: %s (position: -3).

act_file [a pathlike object or string representing an existing file] ACT 5TT image file. Maps to a command-line argument: -act %s (position: -4).

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})
Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> gen5tt = mrt.Generate5tt()
>>> gen5tt.inputs.in_file = 'T1.nii.gz'
>>> gen5tt.inputs.algorithm = 'fsl'
>>> gen5tt.inputs.out_file = '5tt.mif'
>>> gen5tt.cmdline
'5ttgen fsl T1.nii.gz 5tt.mif'
>>> gen5tt.run()
```

**algorithm** ['fsl' or ‘gif’ or ‘freesurfer’ or ‘hsvs’] Tissue segmentation algorithm. Maps to a command-line argument: %s (position: -3).

**in_file** [a pathlike object or string representing an existing file] Input image. Maps to a command-line argument: -nocrop -sgm_amyg_hipp %s (position: -2).

**out_file** [a pathlike object or string representing a file] Output image. Maps to a command-line argument: %s (position: -1).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})
MRConvert

Link to code

Bases: nipype.interfaces.base.CommandLine

Wrapped executable: mrconvert.

Perform conversion with mrconvert between different file types and optionally extract a subset of the input image.

If used correctly, this program can be a very useful workhorse. In addition to converting images between different formats, it can be used to extract specific studies from a data set, extract a specific region of interest, flip the images, or to scale the intensity of the images.

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> mrconvert = mrt.MRConvert()
>>> mrconvert.inputs.in_file = 'dwi_FA.mif'
>>> mrconvert.inputs.out_filename = 'dwi_FA.nii'
>>> mrconvert.run()
```

**in_dir** [a pathlike object or string representing an existing directory] Directory containing DICOM files.

Maps to a command-line argument: %s (position: -2). Mutually exclusive with inputs: in_file, in_dir.

**in_file** [a pathlike object or string representing an existing file] Voxel-order data filename. Maps to a command-line argument: %s (position: -2). Mutually exclusive with inputs: in_file, in_dir.

**args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})

**extension** ['mif' or 'nii' or 'float' or 'char' or 'short' or 'int' or 'long' or 'double'] “i.e. Bfloat”. Can be “char”, “short”, “int”, “long”, “float” or “double”. (Nipype default value: mif)

**extract_at_axis** [1 or 2 or 3] Extract data only at the coordinates specified. This option specifies the Axis. Must be used in conjunction with extract_at_coordinate. Maps to a command-line argument: -coord %s (position: 1).

**extract_at_coordinate** [a list of from 1 to 3 items which are an integer] Extract data only at the coordinates specified. This option specifies the coordinates. Must be used in conjunction with extract_at_axis. Three comma-separated numbers giving the size of each voxel in mm. Maps to a command-line argument: %s (position: 2).


**grad** [a pathlike object or string representing an existing file] Gradient encoding, supplied as a 4xN text file with each line is in the format [ X Y Z b ], where [ X Y Z ] describe the direction of the applied gradient, and b gives the b-value in units (1000 s/mm^2). See FSL2MRTrix. Maps to a command-line argument: -grad %s (position: 9).

**grad_fsl** [a tuple of the form: (a pathlike object or string representing an existing file, a pathlike object or string representing an existing file)] [bvec, bvals] DW gradient scheme (FSL format). Maps to a command-line argument: -fslgrad %s %s.
layout ['nii' or 'float' or 'char' or 'short' or 'int' or 'long' or 'double'] Specify the layout of the data in memory. The actual layout produced will depend on whether the output image format can support it. Maps to a command-line argument: \(--\text{output} \ %s\) (position: 5).

offset_bias [a float] Apply offset to the intensity values. Maps to a command-line argument: \(--\text{scale} \ %d\) (position: 7).

out_filename [a pathlike object or string representing a file] Output filename. Maps to a command-line argument: \(%s\) (position: -1).

output_datatype ['float32' or 'float32le' or 'float32be' or 'float64' or 'float64le' or 'float64be' or 'int64' or 'uint64' or 'uint64le' or 'uint64be' or 'int32' or 'uint32' or 'int32le' or 'uint32le' or 'int32be' or 'uint32be' or 'int16' or 'uint16' or 'uint16le' or 'uint16be' or 'int16be' or 'uint16be' or 'cfloat32' or 'cfloat32le' or 'cfloat32be' or 'cfloat64' or 'cfloat64le' or 'cfloat64be' or 'int8' or 'uint8' or 'bit'] Specify output image data type. Valid choices are: float32, float32le, float32be, float64, float64le, float64be, int64, uint64, int64le, uint64le, int64be, uint64be, int32, uint32, int32le, uint32le, int32be, uint32be, int16, uint16, int16le, uint16le, int16be, uint16be, cfloat32, cfloat32le, cfloat32be, cfloat64, cfloat64le, cfloat64be, int8, uint8, bit.". Maps to a command-line argument: \(--\text{datatype} \ %s\) (position: 2).

prs [a boolean] Assume that the DW gradients are specified in the PRS frame (Siemens DICOM only). Maps to a command-line argument: \(--\text{prs}\) (position: 3).

quiet [a boolean] Do not display information messages or progress status. Maps to a command-line argument: \(--\text{quiet}\).

replace_nan_with_zero [a boolean] Replace all NaN values with zero. Maps to a command-line argument: \(--\text{zero}\) (position: 8).

resample [a float] Apply scaling to the intensity values. Maps to a command-line argument: \(--\text{scale} \ %d\) (position: 6).

stride [a list of from 3 to 4 items which are an integer] Three to four comma-separated numbers specifying the strides of the output data in memory. The actual strides produced will depend on whether the output image format can support it. Maps to a command-line argument: \(--\text{stride} \ %s\) (position: 3).

voxel_dims [a list of from 3 to 3 items which are a float] Three comma-separated numbers giving the size of each voxel in mm. Maps to a command-line argument: \(--\text{vox} \ %s\) (position: 3).

converted [a pathlike object or string representing an existing file] Path/name of 4D volume in voxel order.

MRCrop

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: mrcrop.

Crops a NIFTI image using the mrcrop tool.
Example

```python
>>> import cmkliaLib.interaces.mrtrix3 as mrt
>>> mrcrop = mrt.MRCrop()
>>> mrcrop.inputs.in_file = 'sub-01_dwi.nii.gz'
>>> mrcrop.inputs.in_mask_file = 'sub-01_mod-dwi_desc-brain_mask.nii.gz'
>>> mrcrop.inputs.out_filename = 'sub-01_desc-cropped_dwi.nii.gz'
>>> mrcrop.run()
```

**in_file** [a pathlike object or string representing an existing file] Input image. Maps to a command-line argument: `%s` (position: -2).

**args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.

**debug** [a boolean] Display debugging messages. Maps to a command-line argument: `-debug` (position: 1).

**environ** [a dictionary with keys which are a bytes or None or a value of class `str` and with values which are a bytes or None or a value of class `str`] Environment variables. (Nipype default value: `{}`)

**in_mask_file** [a pathlike object or string representing an existing file] Input mask. Maps to a command-line argument: `-mask %s` (position: -3).

**out_filename** [a pathlike object or string representing a file] Output cropped image. Maps to a command-line argument: `%s` (position: -1).

**quiet** [a boolean] Do not display information messages or progress status. Maps to a command-line argument: `-quiet` (position: 1).

**cropped** [a pathlike object or string representing an existing file] The output cropped image.

**MRThreshold**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: `mrthreshold`.

Threshold an image using the `mrthreshold` tool.

Example

```python
>>> import cmkliaLib.interaces.mrtrix3 as mrt
>>> mrthresh = mrt.MRCrop()
>>> mrthresh.inputs.in_file = 'sub-01_dwi.nii.gz'
>>> mrthresh.inputs.out_file = 'sub-01_desc-thresholded_dwi.nii.gz'
>>> mrthresh.run()
```

**in_file** [a pathlike object or string representing an existing file] The input image to be thresholded. Maps to a command-line argument: `%s` (position: -3).

**out_file** [a pathlike object or string representing a file]

the output binary image mask.

Maps to a command-line argument: `%s` (position: -2).

**abs_value** [a float] Specify threshold value as absolute intensity. Maps to a command-line argument: `-abs %s` (position: -1).

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args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) 


quiet [a boolean] Do not display information messages or progress status. Maps to a command-line argument: -quiet.

thresholded [a pathlike object or string representing an existing file] Path/name of the output binary image mask.

MRTTransform

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: mrtransform.

Apply spatial transformations or reslice images using the mrtransform tool.

Example

```python
>>> from cmtklib.interfaces.mrtrix3 import MRTTransform
>>> MRxform = MRTTransform()
>>> MRxform.inputs.in_files = 'anat_coreg.mif'
>>> MRxform.inputs.interp = 'cubic'
>>> MRxform.run()
```

in_files [a list of items which are any value] Input images to be transformed. Maps to a command-line argument: %s (position: -2).

degress [a string] Additional parameters to the command. Maps to a command-line argument: %s.

debug [a boolean] Display debugging messages. Maps to a command-line argument: -debug (position: 1).

environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {}) 

flip_x [a boolean] Assume the transform is supplied assuming a coordinate system with the x-axis reversed relative to the MRtrix convention (i.e. x increases from right to left). This is required to handle transform matrices produced by FSL’s FLIRT command. This is only used in conjunction with the -reference option. Maps to a command-line argument: -flipx (position: 1).

interp ['nearest' or 'linear' or 'cubic' or 'sinc'] Set the interpolation method to use when reslicing (choices: nearest,linear, cubic, sinc. Default: cubic). Maps to a command-line argument: -interp %s.

invert [a boolean] Invert the specified transform before using it. Maps to a command-line argument: -inverse (position: 1).

out_filename [a pathlike object or string representing a file] Output image. Maps to a command-line argument: %s (position: -1).

quiet [a boolean] Do not display information messages or progress status. Maps to a command-line argument: -quiet (position: 1).
**reference_image** [a pathlike object or string representing an existing file] In case the transform supplied maps from the input image onto a reference image, use this option to specify the reference. Note that this implicitly sets the -replace option. Maps to a command-line argument: -reference %s (position: 1).

**replace_transform** [a boolean] Replace the current transform by that specified, rather than applying it to the current transform. Maps to a command-line argument: -replace (position: 1).

**template_image** [a pathlike object or string representing an existing file] Reslice the input image to match the specified template image. Maps to a command-line argument: -template %s (position: 1).

**transformation_file** [a pathlike object or string representing an existing file] The transform to apply, in the form of a 4x4 ascii file. Maps to a command-line argument: -transform %s (position: 1).

**out_file** [a pathlike object or string representing an existing file] The output image of the transformation.

---

**MRTrix3Base**

Link to code

Bases: nipype.interfaces.base.core.CommandLine

```
"MRtrix3Base base class inherited by FilterTractogram class.
```

**args** [a string] Additional parameters to the command. Maps to a command-line argument: %s.

**environ** [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})
environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})  
out_file [a pathlike object or string representing a file] Multiplication result file.

SIFT2

Link to code

Bases: MRTrix3Base

Wrapped executable: tcksift2.

Determine an appropriate cross-sectional area multiplier for each streamline using tcksift2 [Smith2015SIFT2].

References

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as cmp_mrt
>>> mrtrix_sift2 = cmp_mrt.SIFT2()
>>> mrtrix_sift2.inputs.in_tracks = 'tractogram.tck'
>>> mrtrix_sift2.inputs.in_fod = 'spherical_harmonics_image.nii.gz'
>>> mrtrix_sift2.inputs.out_file = 'sift2_fiber_weights.txt'
>>> mrtrix_sift2.run()
```

in_fod [a pathlike object or string representing an existing file] Input image containing the spherical harmonics of the fibre orientation distributions. Maps to a command-line argument: %s (position: -2).
in_tracks [a pathlike object or string representing an existing file] Input track file in TCK format. Maps to a command-line argument: %s (position: -3).
act_file [a pathlike object or string representing an existing file] ACT 5TT image file. Maps to a command-line argument: --act %s (position: -4).
args [a string] Additional parameters to the command. Maps to a command-line argument: %s.
environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: {})  
out_file [a pathlike object or string representing a file] Output filtered tractogram. Maps to a command-line argument: %s (position: -1).
out_tracks [a pathlike object or string representing an existing file] Output filtered tractogram.
StreamlineTrack

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: tckgen.

Performs tractography using tckgen.

It can use one of the following models: ‘dt_prob’, ‘dt_stream’, ‘sd_prob’, ‘sd_stream’

where ‘dt’ stands for diffusion tensor, ‘sd’ stands for spherical deconvolution, and ‘prob’ stands for probabilistic.

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> strack = mrt.StreamlineTrack()
>>> strack.inputs.inputmodel = 'SD_PROB'
>>> strack.inputs.in_file = 'data.Bfloat'
>>> strack.inputs.seed_file = 'seed_mask.nii'
>>> strack.run()
```

in_file [a pathlike object or string representing an existing file] The image containing the source data. The type of data required depends on the type of tracking as set in the preceeding argument. For DT methods, the base DWI are needed. For SD methods, the SH harmonic coefficients of the FOD are needed. Maps to a command-line argument: %s (position: 2).

act_file [a pathlike object or string representing an existing file] Use the Anatomically-Constrained Tractography framework during tracking; provided image must be in the 5TT (five - tissue - type) format. Maps to a command-line argument: -act %s.

angle [a float] Set the maximum angle between successive steps (default is 90deg x stepsize / voxelsize). Maps to a command-line argument: -angle %s.

args [a string] Additional parameters to the command. Maps to a command-line argument: %s.

backtrack [a boolean] Allow tracks to be truncated. Maps to a command-line argument: -backtrack.

crop_at_gmwmi [a boolean] Crop streamline endpoints more precisely as they cross the GM-WM interface. Maps to a command-line argument: -crop_at_gmwmi.

cutoff_value [a float] Set the FA or FOD amplitude cutoff for terminating tracks (default is 0.5). Maps to a command-line argument: -cutoff %s.

desired_number_of_tracks [an integer] Sets the desired number of tracks. The program will continue to generate tracks until this number of tracks have been selected and written to the output file (default is 100 for *_STREAM methods, 1000 for *_PROB methods). Maps to a command-line argument: -select %d.

do_not_precompute [a boolean] Turns off precomputation of the legendre polynomial values. Warning: this will slow down the algorithm by a factor of approximately 4. Maps to a command-line argument: -noprecomputed.

environ [a dictionary with keys which are a bytes or None or a value of class ‘str’ and with values which are a bytes or None or a value of class ‘str’] Environment variables. (Nipype default value: { })

gradient_encoding_file [a pathlike object or string representing an existing file] Gradient encoding, supplied as a 4xN text file with each line is in the format [ X Y Z b ] where [ X Y Z ] describe the direction
of the applied gradient, and b gives the b-value in units (1000 s/mm^2). See FSL2MRTRix. Maps to a command-line argument: \texttt{-grad %s}.

**initial\_cutoff\_value** [a float] Sets the minimum FA or FOD amplitude for initiating tracks (default is twice the normal cutoff). Maps to a command-line argument: \texttt{-seed\_cutoff %s}.

**initial\_direction** [a list of from 2 to 2 items which are an integer] Specify the initial tracking direction as a vector. Maps to a command-line argument: \texttt{-seed\_direction %s}.

**inputmodel** ['FACT' or 'iFOD1' or 'iFOD2' or 'Nulldist1' or 'Nulldist2' or 'SD\_Stream' or 'Seedtest' or 'Tensor\_Det' or 'Tensor\_Prob'] Specify the tractography algorithm to use. Valid choices are: FACT, iFOD1, iFOD2, Nulldist1, Nulldist2, SD\_Stream, Seedtest, Tensor\_Det, Tensor\_Prob (default: iFOD2). Maps to a command-line argument: \texttt{-algorithm %s (position: -3). (Nipype default value: FACT)}

**mask\_file** [a pathlike object or string representing an existing file] Mask file. Only tracks within mask. Maps to a command-line argument: \texttt{-mask %s}.

**maximum\_number\_of\_seeds** [an integer] Sets the maximum number of tracks to generate. The program will not generate more tracks than this number, even if the desired number of tracks hasn’t yet been reached (default is 1000 x number of streamlines). Maps to a command-line argument: \texttt{-seeds %d}.

**maximum\_tract\_length** [a float] Sets the maximum length of any track in millimeters (default is 500 mm). Maps to a command-line argument: \texttt{-maxlength %s}.

**minimum\_tract\_length** [a float] Sets the minimum length of any track in millimeters (default is 5 mm). Maps to a command-line argument: \texttt{-minlength %s}.

**out\_file** [a pathlike object or string representing a file] Output data file. Maps to a command-line argument: \texttt{%(position: -1)}.

**rk4** [a boolean] Use 4th-order Runge-Kutta integration (slower, but eliminates curvature overshoot in 1st-order deterministic methods). Maps to a command-line argument: \texttt{-rk4}.

**seed\_file** [a pathlike object or string representing an existing file] Seed file. Maps to a command-line argument: \texttt{-seed\_image %s}.

**seed\_gmwmi** [a pathlike object or string representing an existing file] Seed from the grey matter - white matter interface (only valid if using ACT framework). Maps to a command-line argument: \texttt{-seed\_gmwmi %s}. Requires inputs: \texttt{act\_file}.

**seed\_spec** [a list of from 4 to 4 items which are an integer] Seed specification in voxels and radius (x y z r). Maps to a command-line argument: \texttt{-seed\_sphere %s}.

**step\_size** [a float] Set the step size of the algorithm in mm (default is 0.5). Maps to a command-line argument: \texttt{-step %s}.

**stop** [a boolean] Stop track as soon as it enters any of the include regions. Maps to a command-line argument: \texttt{-stop}.

**unidirectional** [a boolean] Track from the seed point in one direction only (default is to track in both directions). Maps to a command-line argument: \texttt{-seed\_unidirectional}.

**tracked** [a pathlike object or string representing an existing file] Output file containing reconstructed tracts.
Tensor2Vector

Link to code

Bases: nipype.interfaces.base.core.CommandLine

Wrapped executable: tensor2metric.

Generates a map of the major eigenvectors of the tensors in each voxel using tensor2metric.

Example

```python
>>> import cmtklib.interfaces.mrtrix3 as mrt
>>> tensor2vector = mrt.Tensor2Vector()
>>> tensor2vector.inputs.in_file = 'dwi_tensor.mif'
>>> tensor2vector.run()
```

- **in_file** [a pathlike object or string representing an existing file] Diffusion tensor image. Maps to a command-line argument: `%s` (position: -2).
- **args** [a string] Additional parameters to the command. Maps to a command-line argument: `%s`.
- **debug** [a boolean] Display debugging messages. Maps to a command-line argument: `-debug` (position: 1).
- **environ** [a dictionary with keys which are a bytes or None or a value of class `str` and with values which are a bytes or None or a value of class `str`] Environment variables. (Nipype default value: `{}`)
- **out_filename** [a pathlike object or string representing a file] Output vector filename. Maps to a command-line argument: `-vector %s` (position: -1).
- **quiet** [a boolean] Do not display information messages or progress status. Maps to a command-line argument: `-quiet` (position: 1).
- **vector** [a pathlike object or string representing an existing file] The output image of the major eigenvectors of the diffusion tensor image.

Submodules

**cmtklib.config module**

Module that defines methods for handling CMP3 configuration files.

- **cmtklib.config.anat_load_config_json** *(pipeline, config_path)*
  
  Load the JSON configuration file of an anatomical pipeline.

  **Parameters**

  - **pipeline** *(Instance(cmt.pipelines.anatomical.anatomical.AnatomicalPipeline)) – Instance of AnatomicalPipeline*
  
  - **config_path** *(string)* – Path of the JSON configuration file

- **cmtklib.config.anat_save_config** *(pipeline, config_path)*

  Save the configuration file of an anatomical pipeline.

  **Parameters**

  - **pipeline** *(Instance(cmt.pipelines.anatomical.anatomical.AnatomicalPipeline)) – Instance of AnatomicalPipeline*
• config_path (string) – Path of the JSON configuration file

cmtklib.config.check_configuration_format (config_path)
Check format of the configuration file.

Parameters  config_path (string) – Path to pipeline configuration file
Returns ext – Format extension of the pipeline configuration file
Return type  ‘.ini’ or ‘.json’

cmtklib.config.check_configuration_version (config)
Check the version of CMP3 used to generate a configuration.

Parameters  config (Dict) – Dictionary of configuration parameters loaded from JSON file
Returns is_same – True if the version used to generate the configuration matches the version currently used (cmp.info.__version__).
Return type  bool

cmtklib.config.convert_config_ini_2_json (config_ini_path)
Convert a configuration file in old INI format to new JSON format.

Parameters  config_ini_path (string) – Path to configuration file in old INI format
Returns config_json_path – Path to converted configuration file in new JSON format
Return type  string

cmtklib.config.create_configparser_from_pipeline (pipeline, debug=False)
Create a ConfigParser object from a Pipeline instance.

Parameters
• pipeline (Instance (Pipeline)) – Instance of pipeline
• debug (bool) – If True, show additional prints
Returns config – Instance of ConfigParser
Return type  Instance(configparser.ConfigParser)

cmtklib.config.create_subject_configuration_from_ref (project, ref_conf_file, pipeline_type, multiproc_number_of_cores=1)
Create the pipeline configuration file for an individual subject from a reference given as input.

Parameters
• project (cmp.project.CMP_Project_Info) – Instance of cmp.project.CMP_Project_Info
• ref_conf_file (string) – Reference configuration file
• pipeline_type (‘anatomical’, ‘diffusion’, ‘fMRI’) – Type of pipeline
• multiproc_number_of_cores (int) – Number of threads used by Nipype
Returns subject_conf_file – Configuration file of the individual subject
Return type  string

cmtklib.config.dmri_load_config_json (pipeline, config_path)
Load the JSON configuration file of a diffusion pipeline.
Parameters
• pipeline (Instance(cmp.pipelines.diffusion.diffusion.DiffusionPipeline)) – Instance of DiffusionPipeline
• config_path(string) – Path of the JSON configuration file

cmtklib.config.dmri_save_config(pipeline, config_path)
Save the INI configuration file of a diffusion pipeline.

Parameters
• pipeline (Instance(cmp.pipelines.diffusion.diffusion.DiffusionPipeline)) – Instance of DiffusionPipeline
• config_path(string) – Path of the JSON configuration file

cmtklib.config.fmri_load_config_json(pipeline, config_path)
Load the JSON configuration file of a fMRI pipeline.

Parameters
• pipeline (Instance(cmp.pipelines.functional.fMRI.fMRIPipeline)) – Instance of fMRIPipeline
• config_path(string) – Path of the JSON configuration file

cmtklib.config.fmri_save_config(pipeline, config_path)
Save the INI configuration file of a fMRI pipeline.

Parameters
• pipeline (Instance(cmp.pipelines.functional.fMRI.fMRIPipeline)) – Instance of fMRIPipeline
• config_path(string) – Path of the JSON configuration file

cmtklib.config.get_anat_process_detail_json(project_info, section, detail)
Get the value for a parameter key (detail) in the stage section of the anatomical JSON config file.

Parameters
• project_info (Instance(cmp.project.CMP_Project_Info)) – Instance of cmp.project.CMP_Project_Info class
• section(string) – Stage section name
• detail(string) – Parameter key

Returns
Return type The parameter value

cmtklib.config.get_dmri_process_detail_json(project_info, section, detail)
Get the value for a parameter key (detail) in the stage section of the diffusion JSON config file.

Parameters
• project_info (Instance(cmp.project.CMP_Project_Info)) – Instance of cmp.project.CMP_Project_Info class
• section(string) – Stage section name
• detail(string) – Parameter key

Returns
Return type The parameter value
cmtklib.config.get_fmri_process_detail_json(project_info, section, detail)

Get the value for a parameter key (detail) in the stage section of the fMRI JSON config file.

Parameters

- **project_info (Instance(cmp.project.CMP_Project_Info))** – Instance of cmp.project.CMP_Project_Info class
- **section (string)** – Stage section name
- **detail (string)** – Parameter key

Returns

Return type The parameter value

cmtklib.config.get_process_detail_json(project_info, section, detail)

Get the value for a parameter key (detail) in the global section of the JSON config file.

Parameters

- **project_info (Instance(cmp.project.CMP_Project_Info))** – Instance of cmp.project.CMP_Project_Info class
- **section (string)** – Stage section name
- **detail (string)** – Parameter key

Returns

Return type The parameter value

cmtklib.config.save_configparser_as_json(config, config_json_path, ini_mode=False, debug=False)

Save a ConfigParser to JSON file.

Parameters

- **config (Instance(configparser.ConfigParser))** – Instance of ConfigParser
- **config_json_path (string)** – Output path of JSON configuration file
- **ini_mode (bool)** – If True, handles all content stored in strings
- **debug (bool)** – If True, show additional prints

cmtklib.config.set_pipeline_attributes_from_config(pipeline, config, debug=False)

Set the pipeline stage attributes given a configuration.

Parameters

- **pipeline (Instance(Pipeline))** – Instance of pipeline
- **config (Dict)** – Dictionary of configuration parameter loaded from the JSON configuration file
- **debug (bool)** – If True, show additional prints
cmtklib.connectome module

Module that defines CMTK functions and Nipype interfaces for connectome mapping.

CMTK_cmat

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Creates the structural connectivity matrices for a given parcellation scheme.

Examples

```python
>>> from cmtklib.connectome import CMTK_cmat
>>> cmat = CMTK_cmat()
>>> cmat.inputs.base_dir = '/my_directory'
>>> cmat.inputs.track_file = '/path/to/sub-01_tractogram.trk'
>>> cmat.inputs.roi_volumes = ['/path/to/sub-01_space-DWI_atlas-L2018_desc-
\scale1_dseg.nii.gz',
  '/path/to/sub-01_space-DWI_atlas-L2018_desc-
\scale2_dseg.nii.gz',
  '/path/to/sub-01_space-DWI_atlas-L2018_desc-
\scale3_dseg.nii.gz',
  '/path/to/sub-01_space-DWI_atlas-L2018_desc-
\scale4_dseg.nii.gz',
  '/path/to/sub-01_space-DWI_atlas-L2018_desc-
\scale5_dseg.nii.gz']
>>> cmat.inputs.roi_graphmls = ['/path/to/sub-01_atlas-L2018_desc-scale1_-
\dseg.graphml',
  '/path/to/sub-01_atlas-L2018_desc-scale2_-
\dseg.graphml',
  '/path/to/sub-01_atlas-L2018_desc-scale3_-
\dseg.graphml',
  '/path/to/sub-01_atlas-L2018_desc-scale4_-
\dseg.graphml',
  '/path/to/sub-01_atlas-L2018_desc-scale5_-
\dseg.graphml']
>>> cmat.inputs.parcellation_scheme = 'Lausanne2018'
>>> cmat.inputs.output_types = ['gPickle','mat','graphml']
>>> cmat.run()
```

**track_file** [a list of items which are a pathlike object or string representing an existing file] Tractography result.

**additional_maps** [a list of items which are a pathlike object or string representing a file] Additional calculated maps (ADC, gFA, ...).

**atlas_info** [a dictionary with keys which are any value and with values which are any value] Custom atlas information.

**compute_curvature** [a boolean] Compute curvature. (Nipype default value: True)

**output_types** [a list of items which are a string] Output types of the connectivity matrices.

**parcellation_scheme** ['Lausanne2008' or 'Lausanne2018' or 'NativeFreesurfer' or 'Custom'] Parcellation scheme. (Nipype default value: Lausanne2008)
roi_graphmls  [a list of items which are a pathlike object or string representing an existing file] GraphML description of ROI volumes (Lausanne2018).
roi_volumes  [a list of items which are a pathlike object or string representing an existing file] ROI volumes registered to diffusion space.
voxel_connectivity  [a list of items which are a pathlike object or string representing an existing file] ProtrackX connectivity matrices (# seed voxels x # target ROIs).
connectivity_matrices  [a list of items which are a pathlike object or string representing a file] Connectivity matrices.
endpoints_file  [a pathlike object or string representing a file] Numpy files storing the list of fiber endpoint.
endpoints_mm_file  [a pathlike object or string representing a file] Numpy files storing the list of fiber endpoint in mm.
filtered_fiberslabel_files  [a list of items which are a pathlike object or string representing a file] List of fiber start end ROI parcellation label after filtering.
final_fiberlabels_files  [a list of items which are a pathlike object or string representing a file] List of fiber start end ROI parcellation label.
final_fiberslength_files  [a list of items which are a pathlike object or string representing a file] List of fiber length.
streamline_final_file  [a pathlike object or string representing a file] Final tractogram of fibers considered in the creation of connectivity matrices.

cmtklib.connectome.cmat(intrk, roi_volumes, roi_graphmls, parcellation_scheme, compute_curvature=True, additional_maps={}, output_types=['gPickle'], atlas_info={})

Create the connection matrix for each resolution using fibers and ROIs.

Parameters
• intrk (TRK file) – Reconstructed tractogram
• roi_volumes (list) – List of parcellation files for a given parcellation scheme
• roi_graphmls (list) – List of graphmls files that describes parcellation nodes
• parcellation_scheme  (["NativeFreesurfer","Lausanne2008", "Lausanne2018"])
• compute_curvature (Boolean) –
• additional_maps (dict) – A dictionary of key/value for each additional map where the value is the path to the map
• output_types(["gPickle","mat","graphml"])
• atlas_info (dict) – Dictionary storing information such as path to files related to a parcellation atlas / scheme.

cmtklib.connectome.compute_curvature_array(fib)
Computes the curvature array.

cmtklib.connectome.create_endpoints_array(fib, voxelSize, print_info)
Create the endpoints arrays for each fiber.

Parameters
• fib (the fibers data) –
• **voxelSize** (3-tuple) – It contains the voxel size of the ROI image
• **print_info** (bool) – If True, print extra information

**Returns**

• **endpoints** *(matrix of size [#fibers, 2, 3] containing for each fiber the index of its first and last point in the voxelSize volume)*

• **endpoints_mm** *(endpoints in millimeter coordinates)*

**cmtklib.connectome.group_analysis_sconn** *(output_dir, subjects_to_be_analyzed)*

Perform group level analysis of structural connectivity matrices.

**rsfmri_conmat**

**Link to code**

Bases: `nipype.interfaces.base.BaseInterface`

Creates the functional connectivity matrices for a given parcellation scheme.

It applies scrubbing (if enabled), computes the average GM ROI time-series and computes the Pearson’s correlation coefficient between each GM ROI time-series pair.

**Examples**

```python
>>> from cmtklib.connectome import rsfmri_conmat
>>> cmat = rsfmri_conmat()
>>> cmat.inputs.base_dir = '/my_directory'
>>> cmat.inputs.func_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> cmat.inputs.roi_volumes = ['/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale1_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale2_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale3_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale4_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> cmat.inputs.roi_graphmls = ['/path/to/sub-01_atlas-L2018_desc-scale1_dseg.graphml',
                              '/path/to/sub-01_atlas-L2018_desc-scale2_dseg.graphml',
                              '/path/to/sub-01_atlas-L2018_desc-scale3_dseg.graphml',
                              '/path/to/sub-01_atlas-L2018_desc-scale4_dseg.graphml',
                              '/path/to/sub-01_atlas-L2018_desc-scale5_dseg.graphml']
>>> cmat.inputs.parcellation_scheme = 'Lausanne2018'
>>> cmat.inputs.apply_scrubbing = False
>>> cmat.inputs.output_types = ['gPickle','mat','graphml']
>>> cmat.run()
```

**func_file** [a pathlike object or string representing an existing file] FMRI volume.
**DVARS** [a pathlike object or string representing an existing file] DVARS file if scrubbing is performed.

**DVARS_th** [a float] DVARS threshold.

**FD** [a pathlike object or string representing an existing file] FD file if scrubbing is performed.

**FD_th** [a float] FD threshold.

**apply_scrubbing** [a boolean] Apply scrubbing.

**atlas_info** [a dictionary with keys which are any value and with values which are any value] Custom atlas information.

**output_types** [a list of items which are a string] Output types of the connectivity matrices.

**parcellation_scheme** ['Lausanne2008' or 'Lausanne2018' or 'NativeFreesurfer' or 'Custom'] Parcellation scheme. (Nipype default value: Lausanne2008)

**roi_graphmls** [a list of items which are a pathlike object or string representing an existing file] GraphML description file for ROI volumes (used only if parcellation_scheme == Lausanne2018).

**roi_volumes** [a list of items which are a pathlike object or string representing an existing file] ROI volumes registered to functional space.

**avg_timeseries** [a list of items which are a pathlike object or string representing an existing file] ROI average timeseries.

**connectivity_matrices** [a list of items which are a pathlike object or string representing an existing file] Functional connectivity matrices.

**scrubbed_idx** [a pathlike object or string representing an existing file] Scrubbed indices.

**cmtklib.connectome.save_fibers** *(oldhdr, oldfib, fname, indices)*

Stores a new trackvis file fname using only given indices.

**Parameters**

- **oldhdr** *(the tractogram header)* – Tractogram header to use as reference
- **oldfib** *(the fibers data)* – Input fibers
- **fname** *(string)* – Output tractogram filename
- **indices** *(list)* – Indices of fibers included

**cmtklib.diffusion module**

Module that defines CMTK utility functions for the diffusion pipeline.

**ExtractPVEsFrom5TT**

**Link to code**

- Bases: nipype.interfaces.base.core.BaseInterface

Create Partial Volume Estimation maps for CSF, GM, WM tissues from mrtrix3 5TT image.
Examples

```python
>>> from cmtklib.diffusion import ExtractPVEsFrom5TT
>>> pves = ExtractPVEsFrom5TT()
>>> pves.inputs.in_5tt = 'sub-01_desc-5tt_dseg.nii.gz'
>>> pves.inputs.ref_image = 'sub-01_T1w.nii.gz'
>>> pves.inputs.pve_csf_file = '/path/to/output_csf_pve.nii.gz'
>>> pves.inputs.pve_gm_file = '/path/to/output_gm_pve.nii.gz'
>>> pves.inputs.pve_wm_file = '/path/to/output_wm_pve.nii.gz'
>>> pves.run()
```

**in_5tt** [a pathlike object or string representing an existing file] Input 5TT (4D) image.

**pve_csf_file** [a pathlike object or string representing a file] CSF Partial Volume Estimation volume estimated from.

**pve_gm_file** [a pathlike object or string representing a file] GM Partial Volume Estimation volume estimated from.

**pve_wm_file** [a pathlike object or string representing a file] WM Partial Volume Estimation volume estimated from.

**ref_image** [a pathlike object or string representing an existing file] Reference 3D image to be used to save 3D PVE volumes.

**partial_volume_files** [a list of items which are a pathlike object or string representing a file] CSF/GM/WM Partial Volume Estimation images estimated from.

**FlipBvec**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Return a diffusion bvec file with flipped axis as specified by `flipping_axis` input.

Examples

```python
>>> from cmtklib.diffusion import FlipBvec
>>> flip_bvec = FlipBvec()
>>> flip_bvec.inputs.bvecs = 'sub-01_dwi.bvecs'
>>> flip_bvec.inputs.flipping_axis = ['x']
>>> flip_bvec.inputs.delimiter = '
'
>>> flip_bvec.inputs.header_lines = 0
>>> flip_bvec.inputs.orientation = 'h'
>>> flip_bvec.run()
```

**bvecs** [a pathlike object or string representing an existing file] Input diffusion gradient bvec file.

**delimiter** [a string] Delimiter used in the table.

**flipping_axis** [a list of items which are any value] List of axis to be flipped.

**header_lines** [an integer] Line number of table header.

**orientation** ['v' or 'h'] Orientation of the table.

**bvecs_flipped** [a pathlike object or string representing an existing file] Output bvec file with flipped axis.

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FlipTable

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Flip axis and rewrite a gradient table.

Examples

```python
>>> from cmtklib.diffusion import FlipTable
>>> flip_table = FlipTable()
>>> flip_table.inputs.table = 'sub-01_mod-dwi_gradient.txt'
>>> flip_table.inputs.flipping_axis = ['x']
>>> flip_table.inputs.orientation = 'v'
>>> flip_table.inputs.delimiter = ','
>>> flip_table.run()
```

delimiter [a string] Delimiter used in the table.
flipping_axis [a list of items which are any value] List of axis to be flipped.
header_lines [an integer] Line number of table header.
orientation ['v' or 'h'] Orientation of the table.
table [a pathlike object or string representing an existing file] Input diffusion gradient table.
table [a pathlike object or string representing an existing file] Output table with flipped axis.

Make_Mrtrix_Seeds

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Creates seeding ROIs by intersecting dilated ROIs with WM mask for mrtrix.

Examples

```python
>>> from cmtklib.diffusion import Make_Mrtrix_Seeds
>>> make_mrtrix_seeds = Make_Mrtrix_Seeds()
>>> make_mrtrix_seeds.inputs.ROI_files = ['sub-01_space-DWI_atlas-L2018_desc-scale1_dseg.nii.gz',
'sub-01_space-DWI_atlas-L2018_desc-scale2_dseg.nii.gz',
'sub-01_space-DWI_atlas-L2018_desc-scale3_dseg.nii.gz',
'sub-01_space-DWI_atlas-L2018_desc-scale4_dseg.nii.gz',
'sub-01_space-DWI_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> make_mrtrix_seeds.inputs.WM_file = 'sub-01_space-DWI_label-WM_dseg.nii.gz'
>>> make_mrtrix_seeds.run()
```

WM_file [a pathlike object or string representing a file] WM mask file registered to diffusion space.
ROI_files  [a list of items which are a pathlike object or string representing an existing file] ROI files registered to diffusion space.

seed_files  [a list of items which are a pathlike object or string representing an existing file] Seed files for probabilistic tractography.

Make_Mrtrix_Seeds.ROI_idx = []

Make_Mrtrix_Seeds.base_name = ''

Make_Seeds

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Creates seeding ROIs by intersecting dilated ROIs with WM mask for Dipy.

Examples

```python
>>> from cmtklib.diffusion import Make_Seeds
>>> make_dipy_seeds = Make_Seeds()
>>> make_dipy_seeds.inputs.ROI_files = ['sub-01_space-DWI_atlas-L2018_desc-scale1_dseg.nii.gz',
                                          'sub-01_space-DWI_atlas-L2018_desc-scale2_dseg.nii.gz',
                                          'sub-01_space-DWI_atlas-L2018_desc-scale3_dseg.nii.gz',
                                          'sub-01_space-DWI_atlas-L2018_desc-scale4_dseg.nii.gz',
                                          'sub-01_space-DWI_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> make_dipy_seeds.inputs.WM_file = 'sub-01_space-DWI_label-WM_dseg.nii.gz'
>>> make_dipy_seeds.run()
```

WM_file  [a pathlike object or string representing a file] WM mask file registered to diffusion space.

ROI_files  [a list of items which are a pathlike object or string representing an existing file] ROI files registered to diffusion space.

seed_files  [a list of items which are a pathlike object or string representing an existing file] Seed files for probabilistic tractography.

Make_Seeds.ROI_idx = []

Make_Seeds.base_name = ''

Make_Seeds.gen_outputfilelist()
SplitDiffusion

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Extract volumes from diffusion MRI data given a start and end index.

Examples

```python
>>> from cmtklib.diffusion import SplitDiffusion
>>> split_dwi = SplitDiffusion()
>>> split_dwi.inputs.in_file = 'sub-01_dwi.nii.gz'
>>> split_dwi.inputs.start = 5
>>> split_dwi.inputs.end = 30
>>> split_dwi.run()
```

data [an integer] Volume index to end the split.
in_file [a pathlike object or string representing an existing file] Input diffusion MRI file.
start [an integer] Volume index to start the split.
data [a pathlike object or string representing an existing file] Extracted volumes.
padding1 [a pathlike object or string representing a file] Extracted volumes with padding 1.
padding2 [a pathlike object or string representing a file] Extracted volumes with padding 2.

Tck2Trk

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Convert a tractogram in mrtrix TCK format to trackvis TRK format.

Examples

```python
>>> from cmtklib.diffusion import Tck2Trk
>>> tck_to_trk = Tck2Trk()
>>> tck_to_trk.inputs.in_tracks = 'sub-01_tractogram.tck'
>>> tck_to_trk.inputs.in_image = 'sub-01_desc-preproc_dwi.nii.gz'
>>> tck_to_trk.inputs.out_tracks = 'sub-01_tractogram.trk'
>>> tck_to_trk.run()
```

in_image [a pathlike object or string representing an existing file] Input image used to extract the header.
in_tracks [a pathlike object or string representing an existing file] Input track file in MRtrix .tck format.
out_tracks [a pathlike object or string representing a file] Output track file in Trackvis .trk format.
out_tracks [a pathlike object or string representing an existing file] Output track file in Trackvis .trk format.
UpdateGMWMInterfaceSeeding

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Add extra Lausanne2018 structures to the Gray-matter/White-matter interface for tractography seeding.

Examples

```python
>>> from cmtklib.diffusion import UpdateGMWMInterfaceSeeding
>>> update_gmwmi = UpdateGMWMInterfaceSeeding()
>>> update_gmwmi.inputs.in_gmwmi_file = 'sub-01_label-gmwmi_desc-oridseg.nii.gz'
>>> update_gmwmi.inputs.out_gmwmi_file = 'sub-01_label-gmwmi_desc-modif_dseg.nii.gz'
>>> update_gmwmi.inputs.in_roi_volumes = ['sub-01_space-DWI_atlas-L2018_desc-scale1_dseg.nii.gz',
                                           'sub-01_space-DWI_atlas-L2018_desc-scale2_dseg.nii.gz',
                                           'sub-01_space-DWI_atlas-L2018_desc-scale3_dseg.nii.gz',
                                           'sub-01_space-DWI_atlas-L2018_desc-scale4_dseg.nii.gz',
                                           'sub-01_space-DWI_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> update_gmwmi.run()
```

| **in_gmwmi_file** | [a pathlike object or string representing an existing file] Input GMWM interface image used for streamline seeding. |
| **in_roi_volumes** | [a list of items which are a pathlike object or string representing an existing file] Input parcellation images. |
| **out_gmwmi_file** | [a pathlike object or string representing a file] Output GM WM interface used for streamline seeding. |

```python
cmtklib.diffusion.compute_length_array(trkfile=None, streams=None, savefname='lengths.npy')
```

Computes the length of the fibers in a tractogram and returns an array of length.

**Parameters**

- **trkfile** *(TRK file)* – Path to the tractogram in TRK format
- **streams** *(the fibers data)* – The fibers from which we want to compute the length
- **savefname** *(string)* – Output filename to write the length array

**Returns**

- **leng** – Array of fiber lengths

**Return type**

numpy.array

```python
cmtklib.diffusion.filter_fibers(intrk, outtrk='', fiber_cutoff_lower=20, fiber_cutoff_upper=500)
```

Filters a tractogram based on lower / upper cutoffs.

**Parameters**
• **intrk** *(TRK file)* – Path to a tractogram file in TRK format
• **outtrk** *(TRK file)* – Output path for the filtered tractogram
• **fiber_cutoff_lower** *(int)* – Lower number of fibers cutoff (Default: 20)
• **fiber_cutoff_upper** *(int)* – Upper number of fibers cutoff (Default: 500)

cmtklib.functionalMRI module

Module that defines CMTK Nipype interfaces for the Functional MRI pipeline.

**Detrending**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Apply linear, quadratic or cubic detrending on the Functional MRI signal.

**Examples**

```python
>>> from cmtklib.functionalMRI import Detrending
>>> detrend = Detrending()
>>> detrend.inputs.base_dir = '/my_directory'
>>> detrend.inputs.in_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> detrend.inputs.gm_file = ['/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale1_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale2_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale3_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale4_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> detrend.inputs.mode = 'quadratic'
>>> detrend.run()
```

**in_file** [a filename or object implementing the os.PathLike interface] FMRI volume to detrend.

**gm_file** [a list of items which are a filename or object implementing the os.PathLike interface] ROI files registered to fMRI space.

**mode** ['linear' or 'quadratic' or 'cubic'] Detrending order.

**out_file** [a filename or object implementing the os.PathLike interface] Detrended fMRI volume.
Discard_tp

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Discards the n first time frame in functional MRI data.

Examples

```python
>>> from cmtklib.functionalMRI import Discard_tp
>>> discard = Discard_tp()
>>> discard.inputs.base_dir = '/my_directory'
>>> discard.inputs.in_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> discard.inputs.n_discard = 5
>>> discard.run()
```

**in_file**  [a filename or object implementing the os.PathLike interface] Input 4D fMRI image.

**n_discard**  [an integer] Number of n first frames to discard.

**out_file**  [a filename or object implementing the os.PathLike interface] Output 4D fMRI image with discarded frames.

Nuisance_regression

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Regress out nuisance signals (WM, CSF, movements) through GLM.

Examples

```python
>>> from cmtklib.functionalMRI import Nuisance_regression
>>> nuisance = Nuisance_regression()
>>> nuisance.inputs.base_dir = '/my_directory'
>>> nuisance.inputs.in_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> nuisance.inputs.wm_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> nuisance.inputs.csf_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
>>> nuisance.inputs.motion_file = '/path/to/sub-01_motions.par'
>>> nuisance.inputs.gm_file = ['/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale1_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale2_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale3_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale4_dseg.nii.gz',
                             '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale5_dseg.nii.gz']
```

(continues on next page)
nuisance.inputs.global_nuisance = False
nuisance.inputs.csf_nuisance = True
nuisance.inputs.wm_nuisance = True
nuisance.inputs.motion_nuisance = True
nuisance.inputs.nuisance_motion_nb_reg = 36
nuisance.inputs.n_discard = 5
nuisance.run()

brainfile [a filename or object implementing the os.PathLike interface] Eroded brain mask registered to fMRI space.

csf_file [a filename or object implementing the os.PathLike interface] Eroded CSF mask registered to fMRI space.

csf_nuisance [a boolean] If True perform CSF nuisance regression.

global_nuisance [a boolean] If True perform global nuisance regression.

gm_file [a list of items which are a filename or object implementing the os.PathLike interface] GM atlas files registered to fMRI space.

in_file [a filename or object implementing the os.PathLike interface] Input fMRI volume.

motion_file [a filename or object implementing the os.PathLike interface] Motion nuisance effect.

motion_nuisance [a boolean] If True perform motion nuisance regression.

n_discard [an integer] Number of volumes discarded from the fMRI sequence during preprocessing.

motion_nuisance_nb_reg [an integer] Number of reg to use in motion nuisance regression.

wm_file [a filename or object implementing the os.PathLike interface] Eroded WM mask registered to fMRI space.

wm_nuisance [a boolean] If True perform WM nuisance regression.

averageCSF_mat [a filename or object implementing the os.PathLike interface] Output matrix of CSF regression.

averageCSF_npy [a filename or object implementing the os.PathLike interface] Output of CSF regression in npy format.

averageGlobal_mat [a filename or object implementing the os.PathLike interface] Output matrix of global regression.

averageGlobal_npy [a filename or object implementing the os.PathLike interface] Output of global regression in npy format.

averageWM_mat [a filename or object implementing the os.PathLike interface] Output matrix of WM regression.

averageWM_npy [a filename or object implementing the os.PathLike interface] Output of WM regression in npy format.

out_file [a filename or object implementing the os.PathLike interface] Output fMRI Volume.
Scrubbing

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Computes scrubbing parameters: FD and DVARS.

Examples

```python
from cmtklib.functionalMRI import Scrubbing

scrub = Scrubbing()
scrub.inputs.base_dir = '/my_directory'
scrub.inputs.in_file = '/path/to/sub-01_task-rest_desc-preproc_bold.nii.gz'
scrub.inputs.gm_file = ['/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale1_dseg.nii.gz',
                       '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale2_dseg.nii.gz',
                       '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale3_dseg.nii.gz',
                       '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale4_dseg.nii.gz',
                       '/path/to/sub-01_space-meanBOLD_atlas-L2018_desc-scale5_dseg.nii.gz']
scrub.inputs.wm_mask = '/path/to/sub-01_space-meanBOLD_label-WM_dseg.nii.gz'
scrub.inputs.gm_file = '/path/to/sub-01_space-meanBOLD_label-GM_dseg.nii.gz'
scrub.inputs.mode = 'quadratic'
scrub.run()
```

**in_file** [a filename or object implementing the os.PathLike interface] FMRI volume to scrub.

**gm_file** [a list of items which are a filename or object implementing the os.PathLike interface] ROI volumes registered to fMRI space.

**motion_parameters** [a filename or object implementing the os.PathLike interface] Motion parameters from preprocessing stage.

**wm_mask** [a filename or object implementing the os.PathLike interface] WM mask registered to fMRI space.

**dvars_mat** [a filename or object implementing the os.PathLike interface] DVARS matrix for scrubbing.

**dvars_npy** [a filename or object implementing the os.PathLike interface] DVARS in .npy format.

**fd_mat** [a filename or object implementing the os.PathLike interface] FD matrix for scrubbing.

**fd_npy** [a filename or object implementing the os.PathLike interface] FD in .npy format.
**cmtklib.parcellation module**

Module that defines CMTK utility functions and Nipype interfaces for anatomical parcellation.

**CombineParcellations**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Creates the final parcellation.

It combines the original cortico sub-cortical parcellation with the following extra segmented structures:

* Segmentation of the 8 thalamic nuclei per hemisphere
* Segmentation of 14 hippocampal subfields per hemisphere
* Segmentation of 3 brainstem sub-structures

It also generates by defaults the corresponding (1) description of the nodes in graphml format and (2) color lookup tables in FreeSurfer format that can be displayed in freeview.

**Examples**

```python
>>> parc_combine = CombineParcellations()

>>> parc_combine.inputs.input_rois = ['/path/to/sub-01_atlas-L2018_desc-
→scale1_dseg.nii.gz',
'/path/to/sub-01_atlas-L2018_desc-
→scale2_dseg.nii.gz',
'/path/to/sub-01_atlas-L2018_desc-
→scale3_dseg.nii.gz',
'/path/to/sub-01_atlas-L2018_desc-
→scale4_dseg.nii.gz',
'/path/to/sub-01_atlas-L2018_desc-
→scale5_dseg.nii.gz']

>>> parc_combine.inputs.lh_hippocampal_subfields = '/path/to/lh_hippocampal_-
→subfields.nii.gz'

>>> parc_combine.inputs.rh_hippocampal_subfields = '/path/to/rh_hippocampal_-
→subfields.nii.gz'

>>> parc_combine.inputs.brainstem_structures = '/path/to/brainstem_-
→structures.nii.gz'

>>> parc_combine.inputs.thalamus_nuclei = '/path/to/thalamus_nuclei.nii.gz'

>>> parc_combine.inputs.create_colorLUT = True

>>> parc_combine.inputs.create_graphml = True

>>> parc_combine.inputs.subjects_dir = '/path/to/output_dir/freesurfer')

>>> parc_combine.inputs.subject_id = 'sub-01'

>>> parc_combine.run()
```

**brainstem_structures** [a pathlike object or string representing a file] Brainstem segmentation file.

**create_colorLUT** [a boolean] If True, create the color lookup table in FreeSurfer format.

**create_graphml** [a boolean] If True, create the parcellation node description files in graphml format.

**input_rois** [a list of items which are a pathlike object or string representing an existing file] Input parcellation files.

**lh_hippocampal_subfields** [a pathlike object or string representing a file] Input hippocampal subfields file for left hemisphere.
**rh_hippocampal_subfields** [a pathlike object or string representing a file] Input hippocampal subfields file for right hemisphere.

**subject_id** [a string] Freesurfer subject id.

**subjects_dir** [a pathlike object or string representing a directory] Freesurfer subjects dir.

**thalamus_nuclei** [a pathlike object or string representing a file] Thalamic nuclei segmentation file.

**verbose_level** [1 or 2] Verbose level (1: partial (default) / 2: full).

**aparc_aseg** [a pathlike object or string representing a file] Modified Freesurfer aparc+aseg file.

**colorLUT_files** [a list of items which are a pathlike object or string representing an existing file] Color lookup table files in Freesurfer format.

**graphML_files** [a list of items which are a pathlike object or string representing an existing file]Parcel- lation node description files in graphml format.

**output_rois** [a list of items which are a pathlike object or string representing an existing file] Output parcellation with all structures combined.

\[\text{CombineParcellations.} \text{ismember}(b)\]

**ComputeParcellationRoiVolumes**

Link to code

Bases: nipype.interfaces.base.core.BaseInterface

Computes the volumes of each ROI for each parcellation scale.

**Examples**

```python
>>> compute_vol = ComputeParcellationRoiVolumes()
>>> compute_vol.inputs.roi_volumes = ['./path/to/sub-01_atlas-L2018_desc-scale1_dseg.nii.gz',
                                        './path/to/sub-01_atlas-L2018_desc-scale2_dseg.nii.gz',
                                        './path/to/sub-01_atlas-L2018_desc-scale3_dseg.nii.gz',
                                        './path/to/sub-01_atlas-L2018_desc-scale4_dseg.nii.gz',
                                        './path/to/sub-01_atlas-L2018_desc-scale5_dseg.nii.gz']
>>> compute_vol.inputs.roi_graphmls = ['./path/to/sub-01_atlas-L2018_desc-scale1_dseg.graphml',
                                           './path/to/sub-01_atlas-L2018_desc-scale2_dseg.graphml',
                                           './path/to/sub-01_atlas-L2018_desc-scale3_dseg.graphml',
                                           './path/to/sub-01_atlas-L2018_desc-scale4_dseg.graphml',
                                           './path/to/sub-01_atlas-L2018_desc-scale5_dseg.graphml']
>>> compute_vol.inputs.parcellation_scheme = ['Lausanne2018']
>>> compute_vol.run()
```
parcellation_scheme ['NativeFreesurfer' or 'Lausanne2008' or 'Lausanne2018'] Parcellation scheme. (Nipype default value: Lausanne2018)

roi_graphMLs [a list of items which are a pathlike object or string representing an existing file] GraphML description of ROI volumes (Lausanne2018).

roi_volumes [a list of items which are a pathlike object or string representing an existing file] ROI volumes registered to diffusion space.

roi_volumes_stats [a list of items which are a pathlike object or string representing a file] TSV files with computed parcellation ROI volumes.

Erode

Link to code

Bases: nipype.interfaces.base.core.BaseInterface
Erodes a mask.

Examples

```python
>>> erode = Erode()
>>> erode.inputs.in_file = '/path/to/sub-01_desc-brain_mask.nii.gz'
>>> erode.run()
```

in_file [a pathlike object or string representing an existing file] Input mask to erode.
out_file [a pathlike object or string representing an existing file] Eroded mask.

Parcellate

Link to code

Bases: nipype.interfaces.base.core.BaseInterface
Subdivides segmented ROI file into smaller subregions.
This interface interfaces with the CMTK parcellation functions available in cmtklib.parcellation module for all parcellation resolutions of a given scheme.

Example

```python
>>> from cmtklib.parcellation import Parcellate
>>> parcellate = Parcellate()
>>> parcellate.inputs.subjects_dir = '/path/to/output_dir/freesurfer'
>>> parcellate.inputs.subject_id = 'sub-01'
>>> parcellate.inputs.parcellation_scheme = 'Lausanne2018'
>>> parcellate.run()
```

subject_id [a string] Subject ID.

erode_masks [a boolean] If True erode the masks.

parcellation_scheme ['Lausanne2008' or 'Lausanne2018' or 'NativeFreesurfer'] Parcellation scheme. (Nipype default value: Lausanne2008)
**subjects_dir**  [a pathlike object or string representing a directory] Freesurfer main directory.

**T1**  [a pathlike object or string representing a file] T1 image file.

**aparc_aseg**  [a pathlike object or string representing a file] APArc+ASeg image file (in native space).

**aseg**  [a pathlike object or string representing a file] ASeg image file (in native space).

**brain**  [a pathlike object or string representing a file] Brain-masked T1 image file.

**brain_eroded**  [a pathlike object or string representing a file] Eroded brain file in original space.

**brain_mask**  [a pathlike object or string representing a file] Brain mask file.

**csf_eroded**  [a pathlike object or string representing a file] Eroded csf file in original space.

**csf_mask_file**  [a pathlike object or string representing a file] Cerebrospinal fluid (CSF) mask file.

**gray_matter_mask_file**  [a pathlike object or string representing a file] Cortical gray matter (GM) mask file.

**ribbon_file**  [a pathlike object or string representing an existing file] Image file detailing the cortical ribbon.

**roi_files_in_structural_space**  [a list of items which are a pathlike object or string representing an existing file] ROI image resliced to the dimensions of the original structural image.

**white_matter_mask_file**  [a pathlike object or string representing a file] White matter (WM) mask file.

**wm_eroded**  [a pathlike object or string representing a file] Eroded wm file in original space.

---

**ParcellateBrainstemStructures**

**Link to code**

```
Bases: nipype.interfaces.base.core.BaseInterface

Parcellates the brainstem sub-structures using Freesurfer [Iglesias2015Brainstem].
```

**References**

**Examples**

```python
>>> parc_bstem = ParcellateBrainstemStructures()
>>> parc_bstem.inputs.subjects_dir = '/path/to/derivatives/freesurfer'
>>> parc_bstem.inputs.subject_id = 'sub-01'
>>> parc_bstem.run()
```

**subject_id**  [a string] Subject ID.

**subjects_dir**  [a pathlike object or string representing a directory] Freesurfer main directory.

**brainstem_structures**  [a pathlike object or string representing a file] Parcellated brainstem structures file.

---

5.6. Packages and modules
ParcellateHippocampalSubfields

Link to code

Bases: nipype.interfaces.base.core.BaseInterface
Parcellates the hippocampal subfields using Freesurfer [Iglesias2015Hippo].

References

Examples

```python
def parcellate_hippo(subjects_dir, subject_id):
    parc_hippo = ParcellateHippocampalSubfields()
    parc_hippo.inputs.subjects_dir = subjects_dir
    parc_hippo.inputs.subject_id = subject_id
    parc_hippo.run()
```

subject_id [a string] Subject ID.
subjects_dir [a pathlike object or string representing a directory] Freesurfer main directory.
lh_hipposubfields [a pathlike object or string representing a file] Left hemisphere hippocampal subfields file.
rh_hipposubfields [a pathlike object or string representing a file] Right hemisphere hippocampal subfields file.

ParcellateThalamus

Link to code

Bases: nipype.interfaces.base.core.BaseInterface
Parcellates the thalamus into 8 nuclei using an atlas-based method [Najdenovska18].

References

Examples

```python
def parcellate_thal(T1w_image, bids_dir, subject, template_image, thalamic_nuclei_maps, subjects_dir, subject_id, ants_precision_type):
    parc_thal = ParcellateThalamus()
    parc_thal.inputs.T1w_image = T1w_image
    parc_thal.inputs.bids_dir = bids_dir
    parc_thal.inputs.subject = subject
    parc_thal.inputs.template_image = template_image
    parc_thal.inputs.thalamic_nuclei_maps = thalamic_nuclei_maps
    parc_thal.inputs.subjects_dir = subjects_dir
    parc_thal.inputs.subject_id = subject_id
    parc_thal.inputs.ants_precision_type = ants_precision_type
    parc_thal.run()
```

T1w_image [a pathlike object or string representing a file] T1w image to be parcellated.
subject_id [a string] Subject ID.
subjects_dir [a pathlike object or string representing a directory] Freesurfer main directory.

template_image [a pathlike object or string representing a file] Template T1w.

thalamic_nuclei_maps [a pathlike object or string representing a file] Probability maps of thalamic nuclei (4D image) in template space.

ants_precision_type ['double' or 'float'] Precision type used during computation.

bids_dir [a pathlike object or string representing a directory] BIDS root directory.

session [a string] Session id.

subject [a string] Subject id.

inverse_warped_image [a pathlike object or string representing a file] Inverse warped template.

max_prob_registered [a pathlike object or string representing a file] Max probability label image (native).

prob_maps_registered [a pathlike object or string representing a file] Probabilistic map of thalamus nuclei (native).

thalamus_mask [a pathlike object or string representing a file] Thalamus mask.

transform_file [a pathlike object or string representing a file] Transform file.

warp_file [a pathlike object or string representing a file] Deformation file.

warped_image [a pathlike object or string representing a file] Template registered to T1w image (native).

cmtklib.parcellation.create_T1_and_Brain(subject_id, subjects_dir)
Generates T1, T1 masked and aseg+aparc Freesurfer images in NIFTI format.

Parameters

- subject_id (string) – Freesurfer subject id
- subjects_dir (string) – Freesurfer subjects dir (Typically /path/to/output_dir/freesurfer)

cmtklib.parcellation.create_annot_label(subject_id, subjects_dir)
Creates annotation labels for the Lausanne2008 parcellation scheme.

Parameters

- subject_id (string) – Freesurfer subject id
- subjects_dir (string) – Freesurfer subjects dir (Typically /path/to/output_dir/freesurfer)

cmtklib.parcellation.create_roi(subject_id, subjects_dir)
Iteratively creates the ROI_%s.nii.gz files using the given Lausanne2008 parcellation information from networks.

Parameters

- subject_id (string) – Freesurfer subject id
- subjects_dir (string) – Freesurfer subjects dir (Typically /path/to/output_dir/freesurfer)

cmtklib.parcellation.create_roi_v2(subject_id, subjects_dir, v=True)
Iteratively creates the ROI_%s.nii.gz files using the given Lausanne2018 parcellation information from networks.

Parameters
• **subject_id** (*string*) – Freesurfer subject id

• **subjects_dir** (*string*) – Freesurfer subjects dir (Typically `/path/to/output_dir/freesurfer`)

• **v** (*Boolean*) – Verbose mode

**cmtklib.parcellation.create_wm_mask** *(subject_id, subjects_dir)*

Creates the white-matter mask using the Freesurfer ribbon as basis in the Lausanne2008 framework.

**Parameters**

• **subject_id** (*string*) – Freesurfer subject id

• **subjects_dir** (*string*) – Freesurfer subjects dir (Typically `/path/to/output_dir/freesurfer`)

**cmtklib.parcellation.create_wm_mask_v2** *(subject_id, subjects_dir, v=True)*

Creates the white-matter mask using the Freesurfer ribbon as basis in the Lausanne2018 framework.

**Parameters**

• **subject_id** (*string*) – Freesurfer subject id

• **subjects_dir** (*string*) – Freesurfer subjects dir (Typically `/path/to/output_dir/freesurfer`)

• **v** (*Boolean*) – Verbose mode

**cmtklib.parcellation.crop_and_move_WM_and_GM** *(subject_id, subjects_dir)*

Converts Freesurfer images back to original native space when NativeFreesurfer parcellation scheme is used.

**Parameters**

• **subject_id** (*string*) – Freesurfer subject id

• **subjects_dir** (*string*) – Freesurfer subjects dir (Typically `/path/to/output_dir/freesurfer`)

• **v** (*Boolean*) – Verbose mode

**cmtklib.parcellation.crop_and_move_datasets** *(parcellation_scheme, subject_id, subjects_dir)*

Converts Freesurfer images back to original native space when Lausanne20XX parcellation schemes are used.

**Parameters**

• **parcellation_scheme** (*string*) – Parcellation scheme: ‘Lausanne2008’, ‘Lausanne2018’

• **subject_id** (*string*) – Freesurfer subject id

• **subjects_dir** (*string*) – Freesurfer subjects dir (Typically `/path/to/output_dir/freesurfer`)

**cmtklib.parcellation.define_atlas_variables** *

Returns a dictionary containing atlas information for the Lausanne2018 parcellation scheme.

---

**Note:** atlas_info often used in the code refers to such a dictionary.

**cmtklib.parcellation.erode_mask** *(fsdir, maskFile)*

Erodes the mask and saves it the Freesurfer subject directory.

**Parameters**

• **fsdir** (*string*) – Freesurfer subject directory
• **maskFile**(string) – Path to mask file

cmtklib.parcellation.extract(Z, shape, position, fill)

Extract voxel neighbourhood.

**Parameters**

- **Z**(numpy.array) – The original data
- **shape**(tuple) – Tuple containing neighbourhood dimensions
- **position**(tuple) – Tuple containing central point indexes
- **fill**(value) – Value for the padding of Z

**Returns** R – The output neighbourhood of the specified point in Z

**Return type** numpy.array

cmtklib.parcellation.generate_WM_and_GM_mask(subject_id, subjects_dir)

Generates the white-matter and gray-matter masks when NativeFreesurfer parcellation is used.

**Parameters**

- **subject_id**(string) – Freesurfer subject id
- **subjects_dir**(string) – Freesurfer subjects dir (Typically /path/to/output_dir/freesurfer)

cmtklib.parcellation.generate_single_parcellation(v, i, fs_string, subject_dir, subject_id)

Generates the volumetric parcellation from the annotation file for one scale of Lausanne2018 parcellation.

**Parameters**

- **v**(Boolean) – Verbose mode
- **i**(int) – Parcellation scale index
- **fs_string**(string) – Command executed before running Freesurfer tool
- **subject_id**(string) – Freesurfer subject id
- **subject_dir**(string) – Freesurfer subject dir (Typically /path/to/output_dir/freesurfer/<subject_id>)

cmtklib.parcellation.get_parcellation(parcel='NativeFreesurfer')

Returns a dictionary containing atlas information.

**Note:** atlas_info often used in the code refers to such a dictionary.

**Parameters parcel** (parcellation scheme) – It can be: ‘NativeFreesurfer’, ‘Lausanne2008’ or ‘Lausanne2018’
cmtklib.util module

Module that defines CMTK Utility functions.

class cmtklib.util.BColors
    Bases: object
    Utility class for color unicode.
    BOLD = '\x1b[1m'
    ENDC = '\x1b[0m'
    FAIL = '\x1b[91m'
    HEADER = '\x1b[95m'
    OKBLUE = '\x1b[94m'
    OKGREEN = '\x1b[92m'
    UNDERLINE = '\x1b[4m'
    WARNING = '\x1b[93m'

cmtklib.util.extract_freesurfer_subject_dir (reconall_report, local_output_dir=None, debug=False)
    Extract Freesurfer subject directory from the report created by Nipype Freesurfer Recon-all node.
    Parameters
    • reconall_report (string) – Path to the recon-all report
    • local_output_dir (string) – Local output / derivatives directory
    • debug (bool) – If True, show printed outputs
    Returns fs_subject_dir – Freesurfer subject directory
    Return type string

cmtklib.util.get_node_dictionary_outputs (node_report, local_output_dir=None, debug=False)
    Read the Nipype node report and return a dictionary of node outputs.
    Parameters
    • node_report (string) – Path to node report
    • local_output_dir (string) – Local output / derivatives directory
    • debug (bool) – If True, print output dictionary
    Returns dict_outputs – dictionary of outputs extracted from node execution report
    Return type dict

cmtklib.util.get_pipeline_dictionary_outputs (datasink_report, local_output_dir=None, debug=False)
    Read the Nipype datasink report and return a dictionary of pipeline outputs.
    Parameters
    • datasink_report (string) – Path to the datasink report
    • local_output_dir (string) – Local output / derivatives directory
    • debug (bool) – If True, print output dictionary
**Returns** `dict_outputs` – Dictionary of pipeline outputs

**Return type** `dict`

cmtklib.util.length(xyz, along=False)

Euclidean length of track line.

**Parameters**

- `xyz (array-like shape (N,3))` – array representing x,y,z of N points in a track
- `along (bool, optional)` – If True, return array giving cumulative length along track, otherwise (default) return scalar giving total length.

**Returns** `L` – scalar in case of `along == False`, giving total length, array if `along == True`, giving cumulative lengths.

**Return type** `scalar or array shape (N-1,)`

**Examples**

```python
>>> xyz = np.array([[1, 1, 1], [2, 3, 4], [0, 0, 0]])
>>> expected_lens = np.sqrt([1+2**2+3**2, 2**2+3**2+4**2])
>>> length(xyz) == expected_lens.sum()
True
>>> len_along = length(xyz, along=True)
>>> np.allclose(len_along, expected_lens.cumsum())
True
>>> length([])
0
>>> length([[1, 2, 3]])
0
>>> length([], along=True)
array([0])
```

cmtklib.util.load_graphs(output_dir, subjects, parcellation_scheme, weight)

Return a dictionary of connectivity matrices (graph adjacency matrices).

Still in development

**Parameters**

- `output_dir (string)` – Output/derivatives directory
- `subjects (list)` – List of subject
- `parcellation_scheme (['NativeFreesurfer', 'Lausanne2008', 'Lausanne2018'])` – Parcellation scheme
- `weight (["number_of_fibers", 'fiber_density',..])` – Edge metric to extract from the graph

**Returns** `connmats` – Dictionary of connectivity matrices

**Return type** `dict`

cmtklib.util.magn(xyz, n=1)

Returns the vector magnitude

**Parameters**

- `xyz (vector)` – Input vector
• n \((\text{int})\) – Tile by \(n\) if \(n>1\) before return

cmtklib.util.mean_curvature\(\text{\(xyz\)}\)
Calculates the mean curvature of a curve.

**Parameters** `xyz` (array-like shape \((N,3)\)) – array representing \(x,y,z\) of \(N\) points in a curve

**Returns** `m` – float representing the mean curvature

**Return type** float

**Examples**

Create a straight line and a semi-circle and print their mean curvatures

```python
>>> from dipy.tracking import metrics as tm
>>> import numpy as np

>>> x=np.linspace(0,1,100)
>>> y=0*x
>>> z=0*x
>>> xyz=np.vstack((x,y,z)).T
>>> m=tm.mean_curvature(xyz) #mean curvature straight line

>>> theta=np.pi*np.linspace(0,1,100)
>>> x=np.cos(theta)
>>> y=np.sin(theta)
>>> z=0*x
>>> xyz=np.vstack((x,y,z)).T
>>> m=tm.mean_curvature(xyz) #mean curvature for semi-circle
```

**cmtklib.util.print_blue**(message)
Print blue-colored message

**Parameters** `message` (string) – The string of the message to be printed

**cmtklib.util.print_error**(message)
Print red-colored error message

**Parameters** `message` (string) – The string of the message to be printed

**cmtklib.util.print_warning**(message)
Print yellow-colored warning message

**Parameters** `message` (string) – The string of the message to be printed

**cmtklib.util.return_button_style_sheet**(image, image_disabled=None, verbose=False)
Return Qt style sheet for QPushButton with image

**Parameters**
- `image` (string) – Path to image to use as icon when button is enabled
- `image_disabled` (string) – Path to image to use as icon when button is disabled
- `verbose` (Bool) – Print the style sheet if True Default: False

**Returns** `button_style_sheet` – Qt style sheet for QPushButton with image

**Return type** string
5.7 Adopting Datalad for collaboration

Datalad is a powerful tool for the versioning and sharing of raw and processed data as well as for the tracking of data provenance (i.e. the recording on how data was processed). This page was created with the intention to share with the user how we adopted datalad to manage and process datasets with Connectome Mapper 3 in our lab, following the YODA principles to our best.

You may ask “What are the YODA principles?”. They are basic principles behind creating, sharing, and publishing reproducible, understandable, and open data analysis projects with DataLad.

For more details and tutorials on Datalad and YODA, please check the recent Datalad Handbook and the YODA principles.

Happy Collaborative and Reproducible Connectome Mapping!

---

**Note:** This was tested on Ubuntu 16.04 with Datalad 0.14.0, its extensions datalad-container 1.1.2, datalad-neuroimaging 0.3.1, and git-annex 8.20210127.

---

5.7.1 Prerequisites

- Python3 must be installed with Datalad and all dependencies. You can use the conda environment py37cmp-gui for instance. See *Installation of py37cmp-gui* for more installation details.
- A recent version of git-annex and liblzma (included in py37cmp-gui for Ubuntu/Debian).
- Docker must be installed on systems running Connectome Mapper 3. See *Prerequisites of Connectome Mapper 3* for more installation instructions.

5.7.2 Copy BIDS dataset to server

Copy the raw BIDS dataset using `rsync`:

```
rsync -P -avz -e 'ssh' \
--exclude 'derivatives' \
--exclude 'code' \
--exclude '.datalad' \
--exclude '.git' \
--exclude '.gitattributes' \
$path/to/ds-example/* \
<SERVER_USERNAME>@<SERVER_IP_ADDRESS>:/archive/data/ds-example
```

where:

- `-P` is used to show progress during transfer
- `-v` increases verbosity
- `-e` specifies the remote shell to use (ssh)
- `-a` indicates archive mode
- `-z` enables file data compression during the transfer
- `--exclude DIR_NAME` exclude the specified DIR_NAME from the copy
5.7.3 Remote datalad dataset creation on Server

Connect to Server

To connect with SSH:

```
ssh <SERVER_USERNAME>@<SERVER_IP_ADDRESS>
```

Creation of Datalad dataset

Go to the source dataset directory:

```
cd /archive/data/ds-example
```

Initialize the Datalad dataset:

```
datalad create -f -c text2git -D "Original example dataset on lab server" -d .
```

where:

- `-f` forces to create the datalad dataset if not empty
- `-c text2git` configures Datalad to use git to manage text file
- `-D` gives a brief description of the dataset
- `-d` specify the location where the Datalad dataset is created

Track all files contained in the dataset with Datalad:

```
datalad save -m "Source (Origin) BIDS dataset" --version-tag origin
```

where:

- `-m MESSAGE` is the description of the state or the changes made to the dataset
- `--version-tag` tags the state of the Dataset

Report on the state of dataset content:

```
datalad status -r
git log
```

5.7.4 Processing using the Connectome Mapper BIDS App on Alice’s workstation

Processed dataset creation

Initialize a datalad dataset with the YODA procedure:

```
datalad create -c text2git -c yoda \
-D "Processed example dataset by Alice with CMP3" \
/home/alice/data/ds-example-processed
```

This will create a datalad dataset with:

- a code directory in your dataset
- three files for human consumption (README.md, CHANEGLOG.md)
• everything in the code/ directory configured to be tracked by Git, not git-annex
• README.md and CHANGELOG.md configured in the root of the dataset to be tracked by Git
• Text files configured to be tracked by Git

Go to the created dataset directory:

cd /home/alice/data/ds-example-processed

Create the derivatives output directory:

mkdir derivatives

### Raw BIDS dataset installation

Install the remove datalad dataset ds-example in /home/alice/data/ds-example-processed/input/:

```
datalad install -d . -s ssh://<SERVER_USERNAME>@<SERVER_IP_ADDRESS>:/archive/data/ds-example /home/alice/data/ds-example-processed/input/
```

where:
- -s SOURCE specifies the URL or local path of the installation source

### Get T1w and Diffusion images to be processed

For reproducibility, create and write datalad get commands to get_required_files_for_analysis.sh:

```
echo "datalad get input/sub-*/ses-*/anat/sub-*_T1w.nii.gz" > code/get_required_files_for_analysis.sh
echo "datalad get input/sub-*/ses-*/dwi/sub-*_dwi.nii.gz" >> code/get_required_files_for_analysis.sh
echo "datalad get input/sub-*/ses-*/dwi/sub-*_dwi.bvec" >> code/get_required_files_for_analysis.sh
echo "datalad get input/sub-*/ses-*/dwi/sub-*_dwi.bval" >> code/get_required_files_for_analysis.sh
```

Save the script to the dataset’s history:

```
datalad save -m "Add script to get the files required for analysis by Alice"
```

Execute the script:

```
sh code/get_required_files_for_analysis.sh
```
## Link the container image with the dataset

Add Connectome Mapper’s container image to the datalad dataset:

```bash
datalad containers-add connectomemapper-bidsapp-<VERSION_TAG> \
--url dhub://sebastientourbier/connectomemapper-bidsapp:<VERSION_TAG> \
-d . \
--call-fmt \\
"docker run --rm -t \\
- v "$(pwd)/input":/bids_dir \\
- v "$(pwd)/code":/bids_dir/code \\
- v "$(pwd)"/derivatives:/output_dir \\
- u "$(id -u)":"$(id -g)" \\
sebastientourbier/connectomemapper-bidsapp:<VERSION_TAG> {cmd}"
```

**Note:** `--call-fmt` specifies a custom docker run command. The current directory is assumed to be the BIDS root directory and retrieve with "$(pwd)"/input and the output directory is inside the derivatives/ folder.

**Important:** The name of the container-name registered to Datalad cannot have dot as character so that a `<VERSION_TAG>` of v3.X.Y would need to be rewritten as v3-X-Y

Copy existing reference pipeline configuration files to `code` folder:

```bash
cp /path/to/existing/ref_anatomical_config.json \
code/ref_anatomical_config.json
cp /path/to/existing/ref_diffusion_config.json \
code/ref_diffusion_config.json
```

Copy FreeSurfer license file to `code` folder:

```bash
cp /path/to/freesurfer/license.txt \
code/license.txt
```

Save the state of the dataset prior to analysis:

```bash
datalad save -m "Alice's test dataset on local \nworkstation ready for analysis with connectomemapper-bidsapp:<VERSION_TAG>" \
--version-tag ready4analysis-<date>-<time>
```

## Run Connectome Mapper with Datalad

Run Connectome Mapper on all subjects:

```bash
datalad containers-run --container-name connectomemapper-bidsapp-<VERSION_TAG> \
--input code/ref_anatomical_config.json \
--input code/ref_diffusion_config.json \
--output derivatives \
/bids_dir /output_dir participant \
--anat_pipeline_config '/bids_dir/[inputs[0]]' \
--dwi_pipeline_config '/bids_dir/[inputs[1]]'
```
**Note:** `datalad containers-run` will take of replacing the `{inputs[i]}` by the value specified by the `--input` flag (Indexing start at 0).

Save the state:

```
datalad save --m "Alice's test dataset on local \nworkstation processed by connectomemapper-bidsapp:<VERSION_TAG>, (Date/Time)" \n--version-tag processed-<date>-<time>
```

Report on the state of dataset content:

```
datalad status -r
git log
```

**Configure a datalad dataset target on the Server**

Create a remote dataset repository and configures it as a dataset sibling to be used as a publication target:

```
datalad create-sibling --name remote -d . \n<SERVER_USERNAME>@<SERVER_IP_ADDRESS>:/archive/data/ds-example-processed
```

See the documentation of `datalad create-sibling` command for more details.

**Update the remote datalad dataset**

Push the datalad dataset with data derivatives to the server:

```
datalad push -d . --to remote
```

**Note:** `--to remote` specifies the remote dataset sibling i.e. `ssh://<SERVER_USERNAME>@<SERVER_IP_ADDRESS>/archive/data/ds-example-processed` previously configured.

**Uninstall all files accessible from the remote**

With DataLad we don’t have to keep those inputs around so you can safely uninstall them without losing the ability to reproduce an analysis:

```
datalad uninstall input/sub-*/*
```
5.7.5 Local collaboration with Bob for Electrical Source Imaging

Processed dataset installation on Bob's workstation

Install the processed datalad dataset `ds-example-processed` in `/home/bob/data/ds-example-processed`:

```
datalad install -s ssh://<SERVER_USERNAME>@<SERVER_IP_ADDRESS>:/archive/data/ds-example-processed /home/bob/data/ds-example-processed
```

Go to datalad dataset clone directory:

```
cd /home/bob/data/ds-example-processed
```

Get connectome mapper output files (Brain Segmentation and Multi-scale Parcellation) used by Bob in his analysis

For reproducibility, write datalad get commands to `get_required_files_for_analysis_by_bob.sh`:

```
echo "datalad get derivatives/cmp/sub-*/ses-*/anat/sub-*/mask.nii.gz" > code/get_required_files_for_analysis_by_bob.sh
echo "datalad get derivatives/cmp/sub-*/ses-*/anat/sub-*/class-*_dseg.nii.gz" >> code/get_required_files_for_analysis_by_bob.sh
echo "datalad get derivatives/cmp/sub-*/ses-*/anat/sub-*/scale*_atlas.nii.gz" >> code/get_required_files_for_analysis_by_bob.sh
```

Save the script to the dataset's history:

```
datalad save -m "Add script to get the files required for analysis by Bob"
```

Execute the script:

```
sh code/get_required_files_for_analysis_by_bob.sh
```

Update derivatives

Update derivatives with data produced by Cartool:

```
cd /home/bob/data/ds-example
mkdir derivatives/cartool
cp [...] 
```

Save the state:

```
datalad save -m "Bob's test dataset on local \nworkstation processed by cartool:<CARTOOL_VERSION>, (Date/Time)" --version-tag processed-<date>--<time>
```

Report on the state of dataset content:

```
datalad status -r
git log
```
Update the remote datalad dataset

Update the remote datalad dataset with data derivatives:

```
datalad push -d . --to origin
```

**Note:** `--to origin` specifies the origin dataset sibling i.e. `ssh://<SERVER_USERNAME>@<SERVER_IP_ADDRESS>:archive/data/ds-example-processed` from which it was cloned.

Uninstall all files accessible from the remote

Again, with DataLad we don’t have to keep those inputs around so you can safely uninstall them without losing the ability to reproduce an analysis:

```
datalad uninstall derivatives/cmp/*
datalad uninstall derivatives/freesurfer/*
datalad uninstall derivatives/nipype/*
```

Authors  Sebastien Tourbier

Version  Revision: 2 (Last modification: 2021 Feb 23)

### 5.8 Running on a cluster (HPC)

Connectome Mapper 3 BIDS App can be run on a cluster using Singularity.

For your convenience, the Singularity image is automatically built along the docker image using Singularity 3.5.1 and deployed to Sylabs.io as (equivalent of DockerHub for Singularity) during continuous integration on CircleCI. It can be freely downloaded with the following command:

```
$ singularity pull library://connectomicslab/default/connectomemapper-bidsapp:latest
```

If you prefer, you can still build the Singularity image on your side using one of the 2 methods described in *Conversion to a Singularity image*.

A list of useful singularity command can be found in *Useful singularity commands*. For more documentation about Singularity, please check the official documentation website.

Happy Large-Scale Connectome Mapping!

#### 5.8.1 Prerequisites

- Singularity must be installed. Check the official documentation webpage for installation instructions.
5.8.2 Running the singularity image

The following example shows how to call from the terminal the Singularity image of the CMP3 BIDS App to perform both anatomical and diffusion pipelines for sub-01, sub-02 and sub-03 of a BIDS dataset whose root directory is located at ${localDir}:

```
$ singularity run --containall \
   --bind ${localDir}:/bids_dir --bind ${localDir}/derivatives:/output_dir \
   library://connectomicslab/default/connectomemapper-bidsapp:latest \
   /bids_dir /output_dir participant --participant_label 01 02 03 \
   --anat_pipeline_config /bids_dir/code/ref_anatomical_config.json \
   --dwi_pipeline_config /bids_dir/code/ref_diffusion_config.json \
   --fs_license /bids_dir/code/license.txt \
   --number_of_participants_processed_in_parallel 3
```

**Note:** As you can see, the `singularity run` command is slightly different from the `docker run`. The docker option flag `-v` is replaced by the `singularity` `--bind` to map local folders inside the container. Last but not least, while docker containers are executed in total isolation, singularity images MUST run with the option flag `--containall`. Otherwise your `$HOME` and `$TMP` directories or your local environment variables might be shared inside the container.

5.8.3 Conversion to a Singularity image

It actually exists two options for Docker to Singularity container image conversion. Let’s say we want to store Singularity-compatible image file in `~/Softwares/singularity/`.

**Option 1 (recommended): Using the Docker image docker2singularity**

1. Build locally in a `/tmp/test` folder:
   ```
   $ mkdir -p /tmp/test
   $ docker run -v /var/run/docker.sock:/var/run/docker.sock \
   -v /tmp/test:/output --privileged -t --rm \
   singularityware/docker2singularity \
   --name cmp-v3.0.0-RC4.simg \
   sebastientourbier/connectomemapper-bidsapp:v3.0.0-RC4
   ```

2. Move the converted image `cmp-|release|` to the `~/Softwares/singularity` folder on the cluster (via ssh using `scp` for instance)
   ```
   $ scp -v /tmp/test/cmp-v3.0.0-RC4.simg <user>@<cluster_url>:/
   ~/Softwares/singularity/cmp-v3.0.0-RC4.simg
   ```

**Advantage(s):** Has never failed

**Disadvantage(s):** Have to make a-priori the conversion locally on a workstation where docker is installed and then upload the converted image to the cluster
Option 2 : Using singularity directly

```
$ singularity build ~/Softwares/singularity/cmp-v3.0.0-RC4.simg \
   docker://sebastientourbier/connectomemapper-bidsapp:v3.0.0-RC4
```

This command will directly download the latest version release of the Docker image from the DockerHub and convert it to a Singularity image.

**Advantage(s):** Can be executed on the cluster directly

**Disadvantage(s):** Has shown to fail because of some docker / singularity version incompatibilities

### 5.8.4 Useful singularity commands

- Display a container’s metadata:
  ```bash
  $ singularity inspect ~/Softwares/singularity/cmp-v3.0.0-RC4.simg
  ```

- Clean cache:
  ```bash
  $ singularity cache clean
  ```

---

**Authors**  Sebastien Tourbier  
**Version**  Revision: 2 (Last modification: 2021 Jan 04)

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5.10 Changes

5.10.1 Version 3.0.0-RC4

Date: March 07, 2021

This version corresponds to the fourth and final release candidate of Connectome Mapper 3 (CMP3). It incorporates the relatively large Pull Request #74 (~270 commits) which includes the following changes such that it marks the end of the release candidate phase.

New features

- CMP3 pipeline configuration files adopt JSON as new format. (PR #76)
- CMP3 is compatible with PyPI for installation. (PR #78)
- BIDS convention naming of data derived from parcellation atlas adopt now the new BIDS entity atlas-<atlas_label> to distinguish data derived from different parcellation atlases. The use of the entity desc-<scale_label> to distinguish between parcellation scale has been replaced by the use of the entity res-<scale_label>. (PR #79)

Updates

- Content of dataset_description.json for each derivatives folder has been updated to conform to BIDS version 1.4.0. (PR #79)

Code refactoring

- Major refactoring of the cmtklib.config module with the addition and replacement of a number of new methods to handle JSON configuration files. (See full diff on GitHub) Configuration files in the old INI format can be converted automatically with the help of the two new methods check_configuration_format() and convert_config_ini_2_json() to detect if configuration files are in the INI format and to make the conversion. (PR #76)
- Major changes to make cmp and cmpbidsappmanager compatible with the Python Package Index (pip) for package distribution and installation. This includes the merge of setup.py and setup_gui.py, which have been merged into one setup.py and a major refactoring to make pip happy, as well as the creation of a new cmp.cli module, migration to cmp.cli module and refactoring of the scripts connectomemapper3, showmatrix_gpickle, and cmpbidsappmanager with correction of code style issues and addition of missing docstrings. (PR #78)

Improvements

- Clean parameters to be saved in configuration files with the new API. (PR #74)
- Clean output printed by the cmpbidsappmanager Graphical User Interface. (PR #74)
- Add in cmtklib.config the three new functions print_error, print_blue, and print_warning to use different colors to differentiate general info (default color), error (red), command or action (blue), and highlight or warning (yellow). (PR #74)
- Clean code and remove a number of commented lines that are now obsolete. (PR #74, PR #79)
Documentation

• Review usage and add a note regarding the adoption of the new JSON format for configuration files. (PR #76)
• Update tutorial on using CMP3 and Datalad for collaboration. (PR #77)
• Update installation instruction of cmpbidsappmanager using pip install .. (PR #78)
• Update list of outputs following the new BIDS derivatives naming convention introduced. (PR #79)

Bug fixes

• Correct attributes related to the diffusion imaging model type multishell. (PR #74)
• Review code in cmtklib/connectome.py for saving functional connectome files in GRAPHML format. (PR #74)

Software Updates

• Update version of datalad and dependencies (PR #77):
  - datalad[full]==0.13.0 to datalad[full]==0.14.0.
  - datalad-container==0.3.1 to datalad-container==1.1.2.
  - datalad_neuroimaging==0.2.0 to datalad-neuroimaging==0.3.1.
  - git-annex=8.20200617 to git-annex=8.20210127.
  - datalad-revolution was removed.

Software development life cycle

• Improve code coverage by calling the methods check_stages_execution() and fill_stages_outputs() on each pipeline when executed with coverage. (PR #75)
• Improve code coverage by saving in test-01 structural connectome files in MAT and GRAPHML format. (PR #74)
• Improve code coverage by saving in test-07 functional connectome files in GRAPHML format. (PR #74)
• Update the list of outputs for all tests. (PR #74)
• Add test-python-install job that test the build and installation of cmp and cmpbidsappmanager packages compatible with pip. (PR #78)

Please check the main pull request 74 page for more details.

5.10.2 Version 3.0.0-RC3

Date: February 05, 2021

This version corresponds to the third release candidate of Connectome Mapper 3. In particular, it integrates Pull Request #62 which includes:

Updates

• MRtrix3 has been updated from 3.0_RC3_latest to 3.0.2.
• Numpy has been updated from 1.18.5 to 1.19.2.
• Nipype has been updated to 1.5.0 to 1.5.1.
• Dipy has been updated from 1.0.0 to 1.3.0.
• CVXPY has been updated from 1.1.5 to 1.1.7.

Documentation
• Update outdated screenshots for GUI documentation page at readthedocs reported at CMTK user-group.
• Correction of multiple typos.

Bug fixes
• Update code for Dipy tracking with DTI model following major changes in Dipy 1.0 (Fix reported issue #54).
• Update to Dipy 1.3.0 has removed the deprecated warnings related to CVXPY when using MAP_MRI (#63)
• Do not set anymore OMP_NUM_THREADS at execution due to allocation errors raised when using numpy function dot in Dipy.

Software development life cycle
• Add Test 08 that runs anatomical and fMRI pipelines with: Lausanne2018 parcellation, FSL FLIRT co-registration, all nuisance regression, linear detrending and scrubbing
• Add Test 09 that runs anatomical and dMRI pipelines with: Lausanne2018 parcellation, FSL FLIRT, Dipy SHORE, MRtrix SD_Stream tracking, MRtrix SIFT tractogram filtering
• Remove deploy_singularity_latest from the workflow for the sake of space on Sylabs.io.

Please check the main pull request 62 page for more details.

5.10.3 Version 3.0.0-RC2-patch1

Date: February 4, 2021

This version fixes bugs in the second release candidate of Connectome Mapper 3 (v3.0.0-RC2). In particular, it includes:

Bug fixes
• Fix the error to save connectome in GraphML format reported in #65 and (Pull Request #66).

Software development life cycle
• Remove publication of the Singularity image to sylabs.io when the master branch is updated for the sake of space (11GB limit)

Commits
• CI: remove publication of latest tag image on sylabs.io for space (2 days ago) - commit c765f79
• Merge pull request #66 from connectomicslab/v3.0.0-RC2-hotfix1 (3 days ago) - commit 0a2603e
• FIX: update g2.node to g2.nodes when saving connectomes as graphml (fix #65) (6 days ago) - commit d629eef
• FIX: enabled/disabled gray-out button “Run BIDS App” with Qt Style sheet [skip ci] (3 weeks ago) - commit 10e78d9
• MAINT: removed commented lines in cmpbidsappmanager/gui.py [skip ci] (3 weeks ago) - commit 4cc11e7
• FIX: check availability of modalities in the BIDS App manager window [skip ci] (3 weeks ago) - commit 80fbee2
• MAINT: update copyright year [skip ci] (3 weeks ago) - commit f7d0fffb
• CI: delete previous container with latest TAG on sylabs.io [skip ci] (4 weeks ago) - commit 15c9b18
• DOC: update tag to latest in runonhpc.rst [skip ci] (4 weeks ago) - commit 3165bcc
• CI: comment lines related to version for singularity push (4 weeks ago) - commit 3952d46
5.10.4 Version 3.0.0-RC2

Date: December 24, 2020

This version corresponds to the second release candidate of Connectome Mapper 3. In particular, it integrates Pull Request #45 which includes:

New feature

- Add SIFT2 tractogram filtering (requested in #48, PR #52).
- Add a tracker to support us seeking for new funding. User is still free to opt-out and disable it with the new option flag `--notrack`.
- Add options suggested by Theaud G et al. (2020) to better control factors having impacts on reproducibility. It includes:
  - Set the number of ITK threads used by ANTs for registration (option flag `--ants_number_of_threads`).
  - Set the seed of the random number generator used by ANTs for registration (option flag `--ants_random_seed`).
  - Set the seed of the random number generator used by MRtrix for tractography seeding and track propagation (option flag `--mrtrix_random_seed`).
- Full support of Singularity (see Software development life cycle).

Code refactoring

- A number of classes describing interfaces to fsl and mrtrix3 have been moved from `cmtklib/interfaces/util.py` to `cmtklib/interfaces/fsl.py` and `cmtklib/interfaces/mrtrix3.py`.
- Capitalize the first letter of a number of class names.
- Lowercase a number of variable names in `cmtklib/parcellation.py`.

Graphical User Interface

- Improve display of qpushbuttons with images in the GUI (PR #52).
- Make the window to control BIDS App execution scrollable.
- Allow to specify a custom output directory.
- Tune new options in the window to control BIDS App multi-threading (OpenMP and ANTs) and random number generators (ANTs and MRtrix).

Documentation

- Full code documentation with `numpydoc`-style docstrings.
- API documentation page at `readthedocs`.

Bug fixes

- Fix the error reported in #17 if it is still occurring.
- Review statements for creating contents of BIDS App entrypoint scripts to fix issue with Singularity converted images reported in #47.
- Install `dc` package inside the BIDS App to fix the issue with FSL BET reported in #50.
- Install `libopenblas` package inside the BIDS App to fix the issue with FSL EDDY_OPENMP reported in #49.
Software development life cycle

- Add a new job `test_docker_fmri` that test the fMRI pipeline.
- Add `build_singularity`, `test_singularity_parcellation`, `deploy_singularity_latest`, and `deploy_singularity_release` jobs to build, test and deploy the Singularity image in CircleCI (PR #56).

Please check the main pull request 45 page for more details.

5.10.5 Version 3.0.0-RC1

Date: August 03, 2020

This version corresponds to the first release candidate of Connectome Mapper 3. In particular, it integrates Pull Request #40 where the last major changes prior to its official release have been made, which includes in particular:

Migration to Python 3

- Fixes automatically with `2to3` and manually a number of Python 2 statements invalid in python 3 including the `print()` function
- Correct automatically PEP8 code style issues with autotpe8
- Correct manually a number of code stly issues reported by Codacy (bandits/pylints/flake8)
- Major dependency upgrades including:
  - dipy 0.15 -> 1.0 and related code changes in `cmtklib/interfaces/dipy` (Check here for more details about Dipy 1.0 changes)

**Warning:** Interface for tractography based on Dipy DTI model and EuDX tractography, which has been drastically changed in Dipy 1.0, has not been updated yet. It will be part of the next release candidate.

- nipype 1.1.8 -> 1.5.0
- pybids 0.9.5 -> 0.10.2
- pydicom 1.4.2 -> 2.0.0
- networkX 2.2 -> 2.4
- statsmodels 0.9.0 -> 0.11.1
- obspy 1.1.1 -> 1.2.1
- traits 5.1 -> 6.0.0
- traitsui 6.0.0 -> 6.1.3
- numpy 1.15.4 -> 1.18.5
- matplotliblib 1.1.8 -> 1.5.0
- fsleyes 0.27.3 -> 0.33.0
- mne 0.17.1 -> 0.20.7
- sphinx 1.8.5 -> 3.1.1
- sphinx_rtd_theme 0.4.3 -> 0.5.0
- recommonmark 0.5.0 -> 0.6.0
New feature

- Option to run Freesurfer recon-all in parallel and to specify the number of threads used by not only Freesurfer but also all softwares relying on OpenMP for multi-threading. This can be achieved by running the BIDS App with the new option flag `--number_of_threads`.

Changes in BIDS derivatives

- Renamed connectivity graph files to better conform to the BIDS extension proposal on connectivity data schema. They are now saved by default in a TSV file as a list of edges.

Code refactoring

- Functions to save and load pipeline configuration files have been moved to `cmtklib/config.py`

Bug fixes

- Major changes in how inspection of stage/pipeline outputs with the graphical user interface (cmpbidsappmanager) which was not working anymore after migration to Python3
- Fixes to compute the structural connectivity matrices following migration to python 3
- Fixes to computes ROI volumetry for Lausanne2008 and NativeFreesurfer parcellation schemes
- Add missing renaming of the ROI volumetry file for the NativeFreesurfer parcellation scheme following BIDS
- Create the mask used for computing peaks from the Dipy CSD model when performing Particle Filtering Tractography (development still on-going)
- Add missing renaming of Dipy tensor-related maps (AD, RD, MD) following BIDS
- Remove all references to use Custom segmentation / parcellation / diffusion FOD image / tractogram, inherited from CMP2 but not anymore functional following the adoption of BIDS standard inside CMP3.

Software development life cycle

- Use Codacy to support code reviews and monitor code quality over time.
- Use coveragepy in CircleCI during regression tests of the BIDS app and create code coverage reports published on our Codacy project page.

- Add new regression tests in CircleCI to improve code coverage:
  - Test 01: Lausanne2018 (full) parcellation + Dipy SHORE + Mrtrix3 SD_STREAM tractography
  - Test 02: Lausanne2018 (full) parcellation + Dipy SHORE + Mrtrix3 ACT iFOV2 tractography
  - Test 03: Lausanne2018 (full) parcellation + Dipy SHORE + Dipy deterministic tractography
  - Test 04: Lausanne2018 (full) parcellation + Dipy SHORE + Dipy Particle Filtering tractography
  - Test 05: Native Freesurfer (Desikan-Killiany) parcellation
  - Test 06: Lausanne2008 parcellation (as implemented in CMP2)

- Moved pipeline configurations for regression tests in CircleCI from `config/` to `.circle/tests/configuration_files`

- Moved lists of expected regression test outputs in CircleCI from `.circle/` to `.circle/tests/expected_outputs`

Please check the pull request 40 page for more details.
5.10.6 Version 3.0.0-beta-RC2

Date: June 02, 2020

This version integrates Pull Request #33 which corresponds to the last beta release that still relies on Python 2.7. It includes in particular:

Upgrade

• Uses fsleyes instead of fslview (now deprecated), which now included in the conda environment of the GUI (py27cmp-gui).

New feature

• Computes of ROI volumetry stored in <output_dir>/sub-<label>(/ses<label>)/anat folder, recognized by their _stats.tsv file name suffix.

Improved replicability

• Sets the MATRIX_RNG_SEED environment variable (used by MRtrix) and seed for the numpy random number generator (numpy.random.seed())

Bug fixes

• Fixes the output inspector window of the cmpbidsappmanager (GUI) that fails to find existing outputs, after adoption of /bids_dir and /output_dir in the bidsapp docker image.
• Fixes the way to get the list of networkx edge attributes in inspect_outputs() of ConnectomeStage for the output inspector window of the cmpbidsappmanager (GUI)
• Added missing package dependencies (fury and vtk) that fixes dipy_CSD execution error when trying to import module actor from dipy.viz to save the results in a png
• Fixes a number of unresolved references identified by pycharm code inspection tool

Code refactoring

• Interfaces for fMRI processing were moved to cmtklib/functionalMRI.py.
• Interface for fMRI connectome creation (rsfmri_conmat) moved to cmtklib/connectome.py

Please check the pull request 33 page for change details.

5.10.7 Version 3.0.0-beta-RC1

Date: March 26, 2020

This version integrates Pull Request #28 which includes in summary:

• A major revision of continuous integration testing and deployment with CircleCI which closes Issue 14 integrates an in-house dataset published and available on Zenodo @ https://doi.org/10.5281/zenodo.3708962.
• Multiple bug fixes and enhancements incl. close Issue 30, update mrtrix3 to RC3 version, bids-app run command generated by the GUI, location of the configuration and log files to be more BIDS compliant.
• Change in tagging beta version which otherwise might not be meaningfull in accordance with the release date (especially when the expected date is delayed due to unexpected errors that might take longer to be fixed than expected).

Please check the pull request 28 page for a full list of changes.
5.10.8 Version 3.0.0-beta-20200227

Date: February 27, 2020

This version addresses multiple issues to make successful conversion and run of the CMP3 BIDS App on HPC (Clusters) using Singularity.

- Revised the build of the master and BIDS App images:
  - Install locales and set $LC_ALL and $LANG to make freesurfer hippocampal subfields and brainstem segmentation (matlab-based) modules working when run in the converted SIngularity image
  - BIDS input and output directories inside the BIDS App container are no longer the /tmp and /tmp/derivatives folders but /bids_dir and /output_dir. .. warning: this might affect the use of Datalad container (To be confirmed.)
  - Fix the branch of mrtix3 to check out
  - Updated metadata

- Fix the configuration of CircleCI to not use Docker layer cache feature anymore as this feature is not included anymore in the free plan for open source projects.
- Improved documentation where the latest version should be dynamically generated everywhere it should appear.

5.10.9 Version 3.0.0-beta-20200206

Date: February 06, 2020

- Implementation of an in-house Nipype interface to AFNI 3DBandPass which can handle to check output as ..++orig.BRIK or as ..tlrc.BRIK (The later can occur with HCP preprocessed fmri data)

5.10.10 Version 3.0.0-beta-20200124

Date: January 24, 2020

- Updated multi-scale parcellation with a new symmetric version:
  1. The right hemisphere labels were projected in the left hemisphere to create a symmetric version of the multiscale cortical parcellation proposed by Cammoun2012.
  2. For scale 1, the boundaries of the projected regions over the left hemisphere were matched to the boundaries of the original parcellation for the left hemisphere.
  3. This transformation was applied for the rest of the scales.
- Updated documentation with list of changes

5.11 Citing

Important:

- If your are using the Connectome Mapper 3 in your work, a manuscript is in preparation, but for now, please acknowledge this software with the following two entries:

### 5.11.1 Poster

- **Organization for Human Brain Mapping 2020** (Abstract; Poster)

![Poster Image](image.png)

#### 5.12 Contributing to Connectome Mapper 3

**Contents**

- Contributing to Connectome Mapper 3
  - Philosophy
  - Contribution Types
    - Report Bugs
    - Fix Bugs
    - Implement Features
5.12.1 Philosophy

The development philosophy for this new version of the Connectome Mapper is to:

I. Enhance interoperability by working with datasets structured following the Brain Imaging Data Structure structured dataset.

II. Keep the code of the processing as much as possible outside of the actual main Connectome Mapper code, through the use and extension of existing Nipype interfaces and an external library (dubbed cmtklib).

III. Separate the code of the graphical interface and the actual main Connectome Mapper code through inheritance of the classes of the actual main stages and pipelines.

IV. Enhance portability by freezing the computing environment with all software dependencies installed, through the adoption of the BIDS App framework relying on light software container technologies.

V. Adopt best modern open-source software practices that includes to continuously test the build and execution of the BIDS App with code coverage and to follow the PEP8 and PEP257 conventions for python code and docstring style conventions.

VI. Follow the all contributors specification to acknowledge any kind of contribution.

This means that contributions in many different ways (discussed in the following subsections) are welcome and will be properly acknowledged! If you have contributed to CMP3 and are not listed as contributor, please add yourself and make a pull request.

This also means that further development, typically additions of other tools and configuration options should go in this direction.

5.12.2 Contribution Types

Report Bugs


If you are reporting a bug, please include:

• Your operating system name and version.
• Any details about your local setup that might be helpful in troubleshooting.
• Detailed steps to reproduce the bug.
Fix Bugs

Look through the GitHub issues for bugs. Anything tagged with “bug” and “help wanted” is open to whoever wants to implement it.

Implement Features

Look through the GitHub issues for features. Anything tagged with “enhancement” and “help wanted” is open to whoever wants to implement it.

Possible enhancements are probably to be included in the following list:

I. Adding of a configuration option to an existing stage
II. Adding a new interface to cmtklib
III. Adding of a new stage
IV. Adding of a new pipeline

The adding of newer configuration options to existing stages should be self-understandable. If the addition is large enough to be considered a “sub-module” of an existing stage, see the Diffusion stage example.

Adding a new stage implies the addition of the stage folder to the cmp/stages and cmp/bidsappmanager/stages directory and according modification of the parent pipeline along with insertion of a new image in cmp/bidsappmanager/stages. Copy-paste of existing stage (such as segmentation stage) is recommended.

Adding a new pipeline implies the creation of a new pipeline script and folder in the cmp/pipelines and cmp/bidsappmanager/pipelines directories. Again copy-pasting an existing pipeline is the better idea here. Modification of cmp/project.py and cmp/bidsappmanager/project.py file is also needed.

Each new module, class or function should be properly documented with a docstring.

Write Documentation

CMP3 could always use more documentation, whether as part of the official CMP3 docs, in docstrings, or even on the web in blog posts, articles, and such.

Submit Feedback

The best way to send feedback is to create an issue at https://github.com/connectomicslab/connectomemapper3/issues.

If you are proposing a feature:

- Explain in detail how it would work.
- Keep the scope as narrow as possible, to make it easier to implement.
- Remember that this is a volunteer-driven project, and that contributions are welcome :)
5.12.3 Get Started!

Ready to contribute? Here’s how to set up Connectome Mapper 3 for local development.

1. Fork the connectomemapper3 repo on GitHub.

2. Clone your fork locally:
   ```
   git clone git@github.com:your_name_here/connectomemapper3.git
   cd connectomemapper3
   ```

3. Create a branch for local development:
   ```
   git checkout -b name-of-your-bugfix-or-feature
   ```

4. Now you can make your changes locally. If you add a new node in a pipeline or a completely new pipeline, we encourage you to rebuild the BIDS App Docker image (See BIDS App build instructions).

   **Note:** Please keep your commit the most specific to a change it describes. It is highly advice to track unstaged files with `git status`, add a file involved in the change to the stage one by one with `git add <file>`. The use of `git add .` is highly disencouraged. When all the files for a given change are staged, commit the files with a brief message using `git commit -m "[COMMIT_TYPE]: Your detailed description of the change."` that describes your change and where [COMMIT_TYPE] can be [FIX] for a bug fix, [ENH] for a new feature, [MAINT] for code maintenance and typo fix, [DOC] for documentation, [CI] for continuous integration testing.

5. When you’re done making changes, push your branch to GitHub:
   ```
   git push origin name-of-your-bugfix-or-feature
   ```

6. Submit a pull request through the GitHub website.

**Pull Request Guidelines**

Before you submit a pull request, check that it meets these guidelines:

1. If the pull request adds functionality, the docs and tests should be updated (See documentation build instructions).
2. Python code and docstring should comply with PEP8 and PEP257 standards.
3. The pull request should pass all tests on GitHub.

**How to build the BIDS App locally**

1. Go to the clone directory of your fork and run the script build_bidsapp.sh
   ```
   cd connectomemapper3
   sh build_bidsapp.sh
   ```

   **Note:** Tag of the version of the image is extracted from cmp/info.py. You might want to change the version in this file to not overwrite an other existing image with the same version.
How to build the documentation locally

1. Install the CMP3 conda environment `py37cmp-gui` with sphinx and all extensions to generate the documentation:

   ```sh
   cd connectomemapper3
   conda env create -f environment.yml
   ```

2. Activate CMP3 conda environment `py37cmp-gui` and install `connectomemapper3`

   ```sh
   conda activate py37cmp-gui
   (py37cmp-gui) python setup.py install
   ```

3. Run the script `build_docs.sh` to generate the HTML documentation in `docs/_build/html`:

   ```sh
   (py37cmp-gui) bash build_docs.sh
   ```

   **Note:** Make sure to have activated the conda environment `py37cmp-gui` before running the script `build_docs.sh`.

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**Version**  Revision: 2

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### 5.13 Support, Bugs and New Feature Requests

If you need any support or have any questions, you can post to the CMTK-users group.

All bugs, concerns and enhancement requests for this software are managed on GitHub and can be submitted at https://github.com/connectomicslab/connectomemapper3/issues. (See Contribute to Connectome Mapper for more details)
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