W616 - Multi-Scale Brain Parcellator: a BIDS App for the Lausanne Connectome Parcellation

S. Tourbier[1], Y. Alemán-Gómez[1,4], A. Griffa[2], M. Bach Cuadra[1,3], P Hagmann[1]

1. Department of Radiology, University Hospital of Lausanne (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland
2. Complex Traits Genetics, CNCR, Vrije Universiteit Amsterdam, The Netherlands
3. Medical Image Analysis Laboratory (MIAL), Centre d'Imagerie BioMédicale (CIBM), Lausanne, Switzerland

Contact:
sebastien.tourbier@alumni.epfl.ch

MOTIVATION

- **Multi-Scale Brain Parcellator: independent tool developed in parallel of the development of the Connectome Mapper 3 (CMP3)** [1, connectomics.org].
- **Implement a 5-scale brain gray matter parcellation** [2] derived from the Desikan-Killiany atlas [3] and extended with new structures i**ncluding a subdivision of the thalamus into 7 nuclei** [4]**, the hippocampus into 12 subfields** [5] **and the brainstem into 4 sub-structures** [6].
- **Such a brain parcellation can serve many add on applications** such as **volumetry**, definition of regions of interest for tractography or functional connectivity analysis.

AIMS

- **Support** datasets with **Brain Imaging Data Structure (BIDS) format** [7]
- **Adopt frameworks** that have **proven to be capable of effective large scale collaboration**

→ **Make** the **multi-scale parcellation** of CMP3 **standalone, accessible**, **portable, inter-operable** and **easy-to-use**

THE PIPELINE

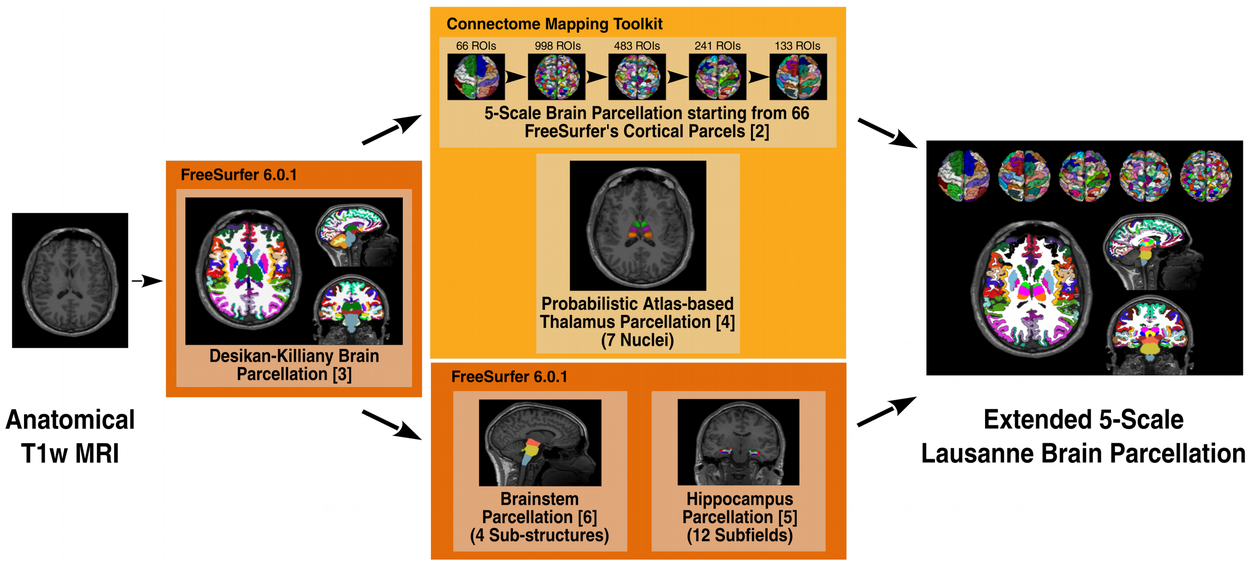

Figure 1: Overview of the Multi-Scale Brain Parcellator processing pipeline. ANTs 2.2.0 [8] is used for linear and symmetric diffeomorphic (SyN) registration.

PROCESSED DATA (DERIVATIVES)

Support BIDS Derivatives

Multi-Scale Brain Parcellator Derivatives

- Derivatives written to <bids_dataset/derivatives>/cmp/sub-<subject_label>/
- Pipeline options and parameters summarized in a configuration .ini file:
  - sub-<subject_label>_anatomical_config.ini
- Anatomical derivatives in the original T1w space saved in each subject's anat subfolder:
  - anat/sub-<subject_label>_desc-head_T1w.nii.gz
  - anat/sub-<subject_label>_desc-brain_T1w.nii.gz
  - anat/sub-<subject_label>_desc-brain_mask.nii.gz
  - anat/sub-<subject_label>_label-WM_dseg.nii.gz
  - anat/sub-<subject_label>_label-GM_dseg.nii.gz
  - anat/sub-<subject_label>_label-CSF_dseg.nii.gz
- The five different brain parcellation are saved as:
  - anat/sub-<subject_label>_label-L2018_desc-<scale_label>_atlas.nii.gz

  where <scale_label> : scale1, scale2, scale3, scale4, scale5 is the parcellation scale.
- Nipype pipeline execution outputs are stored in each subject's tmp subfolder

Freesurfer Derivatives

- A Freesurfer subjects directory is created in <bids_dataset/derivatives>/freesurfer:
- The fsaverage subject distributed with the running version of Freesurfer is copied into this directory

ARCHITECTURE

- **Pipeline of the Multi-Scale Brain Parcellator** is written is **Python** and uses **Nipype** [9] to i**nterface with Freesurfer** and **CMTK** (Connectome Mapper library) in a single workflow.
- **Encapsulated in a BIDS App** [10], a framework based on l**ight container technologies** (Docker [11] and Singularity [12] on HPC) → promotes **portability** and **reproducibility**.

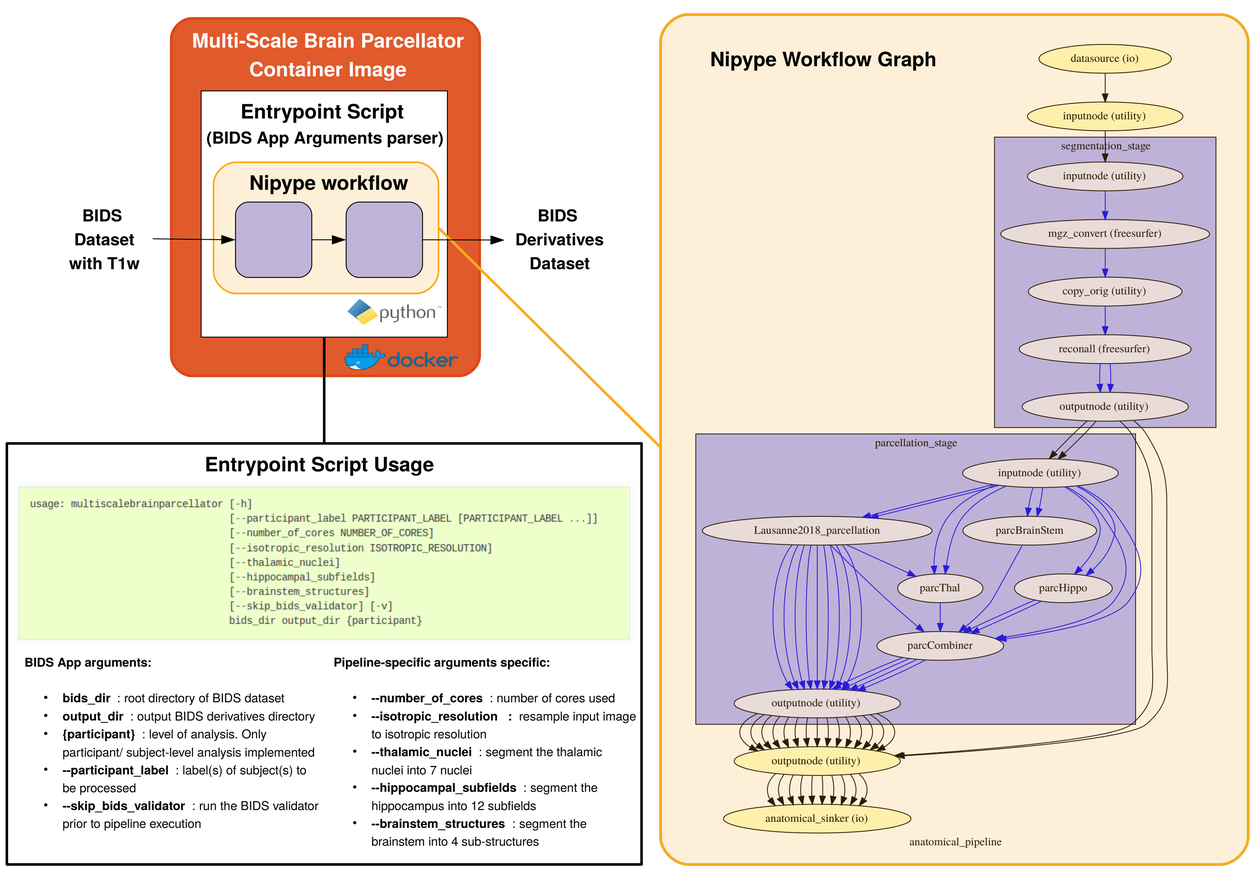

Figure 2: Architecture of Multi-Scale Brain Parcellator

BIDS App Development and Version Release

- **Multi-scale Brain Parcellator** uses **CircleCI** for **Continous Integration Testing**

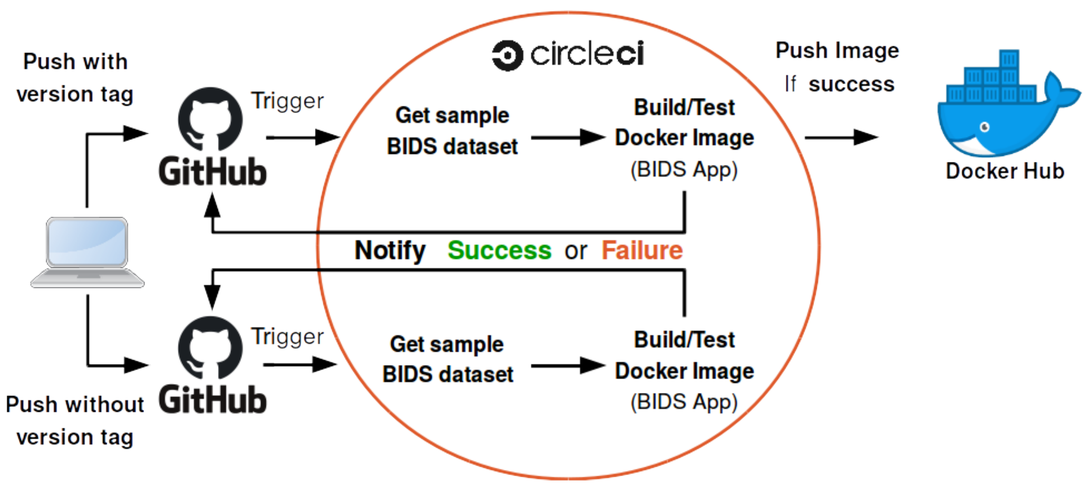

Figure 3: Continous integration flow for the development and version release of the Multi-Scale Brain Parcellator. Each change committed to GitHub repository triggers a "build and test" on CircleCI. When ready to release a version, the version is "tagged" and push to GitHub repository. A version tag will not only trigger a "build and test" on CircleCI but also deploy the new "tagged" docker image to Docker Hub.

RELATED WORK @ OHBM 2019

- See **Poster #T135 "A unified multi-scale probabilistic atlas of the human gray matter"** by Dr. Alemán-Gómez for application of the Multi-Scale Brain Parcellator in the creation of a multi-scale probabilistic atlas of the human gray matter.

DISTRIBUTION

License **BIDS App** **Code** **Docs**

REFERENCES

[1] Daducci et al., PLos ONE 2013; [2] Cammoun et al., J. Neuro. Methods 2012; [3] Desikan et al., Neuroimage 2004; [4] Najdenovska et al., Scientific Data 2018; [5] Iglesias et al., NeuroImage 2015; [6] Iglesias et al., NeuroImage 2015; [7] Gorgolewski et al., Scientific Data 2016; [8] Avants et al., MIA 2018; [9] Gorgolewski et al., Front. Neuro. 2011; [10] Gorgolewski et al., PLos CB 2017; [11] Merkel et al., Linux Journal 2014 ; [12] Kurtzer et al., PLos ONE 2017.

This work was supported in part by the Swiss National Science Foundation under Sinergia Grant under Grant CRSII5_170873.

Brain Communication Pathways
Sinergia Consortium
Swiss National Science Foundation