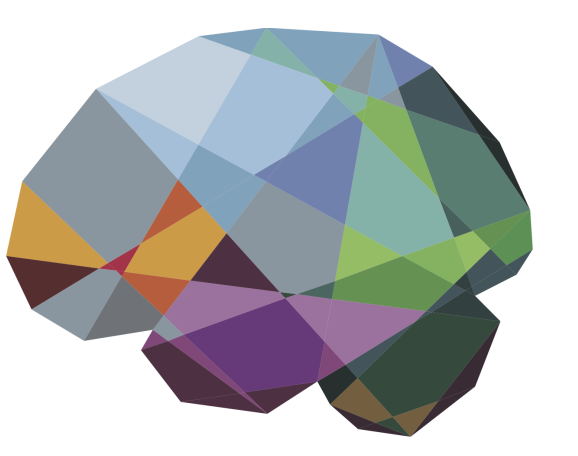




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An automated multi-modal neuroimaging pipeline for large-scale network modelling in TheVirtualBrain



THEVIRTUALBRAIN.

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Introduction

TheVirtualBrain, an open source platform for large-scale network modelling, can be personalized to an individual using a wide range of neuroimaging modalities. The growing number and scale of neuroimaging data sharing initiatives offers an opportunity to create large and heterogeneous sets of personalized models to better understand individual differences in network dynamics. Here we present TheVirtualBrain-UKBiobank (TVB-UKBB) pipeline, a robust and automated neuroimage processing solution to address the expanding scope of TheVirtualBrain project [1].

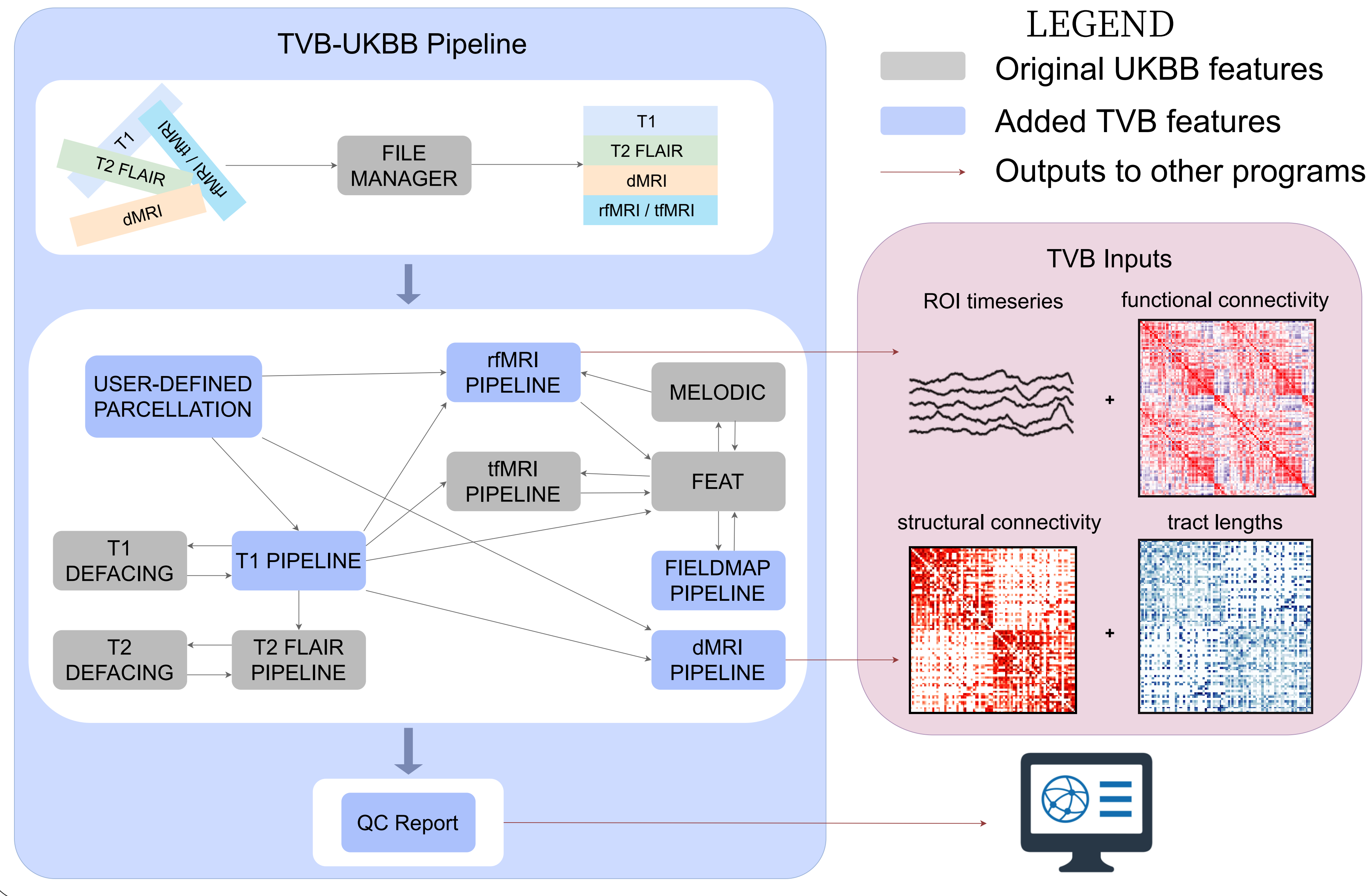
Design

We leverage the existing multimodal MRI processing pipeline from the UKBiobank pipeline made for use with a variety of imaging modalities, including T1w, T2 FLAIR, resting-state and task BOLD-fMRI, and diffusion MRI [2]. We add various features to the original implementation specifically for informing large-scale network models, including user-defined parcellations for the construction of matching whole-brain functional and structural connectomes. New features also include detailed reports for quality control of all modalities and support for various publicly-available datasets.

References

1. <https://thevirtualbrain.org>
2. Alfaro-Almagro et al. (2018) DOI: 10.1016/j.neuroimage.2017.10.034
3. Alzheimer's Disease Neuroimaging Initiative; <http://adni.loni.usc.edu/adni-3/>
4. Cambridge Centre for Ageing and Neuroscience data repository; <https://www.cam-can.org/>
5. Shen et al. (2019) DOI: 10.1038/s41597-019-0129-z

Results



Technical features of the pipeline include support for Linux and SGE (support for Slurm and Singularity is forthcoming), a comprehensive and self-contained installer, support for downloading updates to the pipeline via a publicly available GitHub repository, native support for ADNI3 [3] and Cam-CAN [4] datasets, and outputs that interface directly with TheVirtualBrain. Support for exporting pipeline outputs to the BIDS standard is in development. Other features include: support for a user-defined parcellation that can be applied to resting-state fMRI to generate ROI time series and functional connectivity; tractography using the same parcellation performed with pipeline validated using tracer data [5] to generate structural connectivity and tract lengths; and general documentation on the pipeline and its steps and components.

Discussion

The TVB-UKBB pipeline is open-source, easy to install, and adheres to FAIR principles. The pipeline has been tested on both healthy and clinical populations and is robust to the morphological changes observed in aging and dementia. Future additions will include M/EEG and PET processing. The TVB-UKBB pipeline provides a modular solution for high throughput multi-modal neuroimaging processing with outputs that directly interface with TheVirtualBrain.

