RABIES: an automated pipeline for rodent fMRI image processing.

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Motivation

- Most rodent fMRI preprocessing is conducted through in-house adaptation of human software: sub-optimal quality, time consuming and problematic for reproducibility
- Generalizable registration in rodents is challenging: important site variability in image contrast, geometric distortions and intensity inhomogeneities
- **Goals:** 1) allow for standardized rodent fMRI image processing from preprocessing to analysis. 2) develop high-quality registration workflow reliable across datasets.

Achievements

- First preprocessing workflow achieving robust performance across rodent fMRI sites
- Follows best practices for open science and reproducibility: github (https://github.com/CoBrALab/RABIES), documentation (https://rabies.readthedocs.io/en/stable/), docker container (https://hub.docker.com/r/gabdesgreg/rabies), standardized visual outputs for quality control

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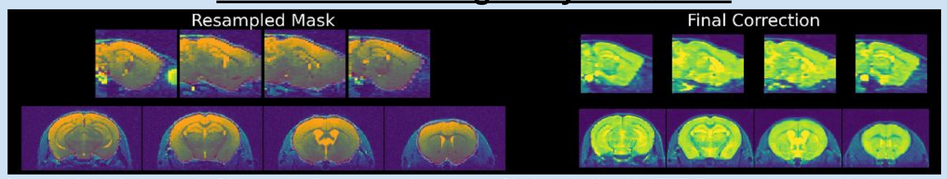
Figure 1: Registration workflow

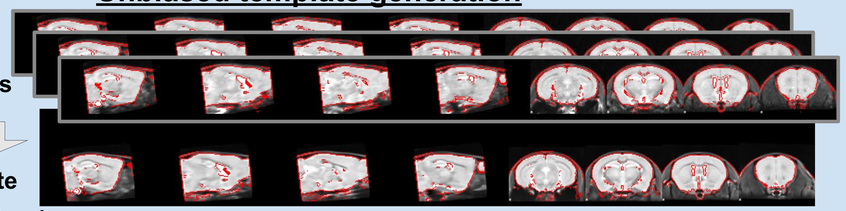
Structural inhomogeneity correction



Manjón et al. (2010). Journal of Magnetic Resonance Imaging. ; Sled et al. (1998). IEEE Transactions on Medical Imaging

Unbiased template generation

All Corrected Structural images

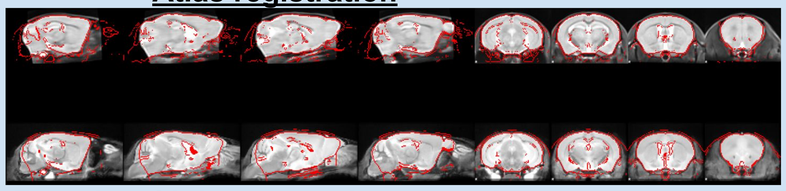


Unbiased template

Avants et al. (2011). NeuroImage.

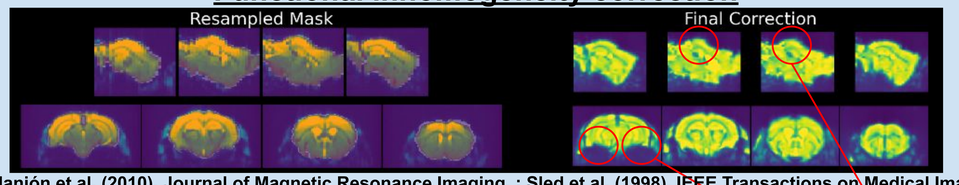
Atlas registration

Unbiased template



Commonspace atlas

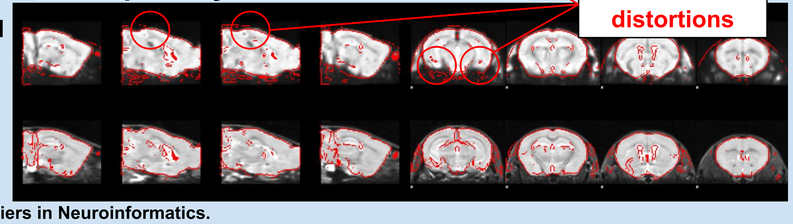
Functional inhomogeneity correction



Manjón et al. (2010). Journal of Magnetic Resonance Imaging. ; Sled et al. (1998). IEEE Transactions on Medical Imaging

Susceptibility distortion correction

Corrected Functional image



Corrected Structural image

Wang et al. (2017). Frontiers in Neuroinformatics.

Take-away: ~99% overall success rate of the registration workflow across 23 fMRI datasets including both rat and mouse species.

Figure 2: RABIES image processing workflow

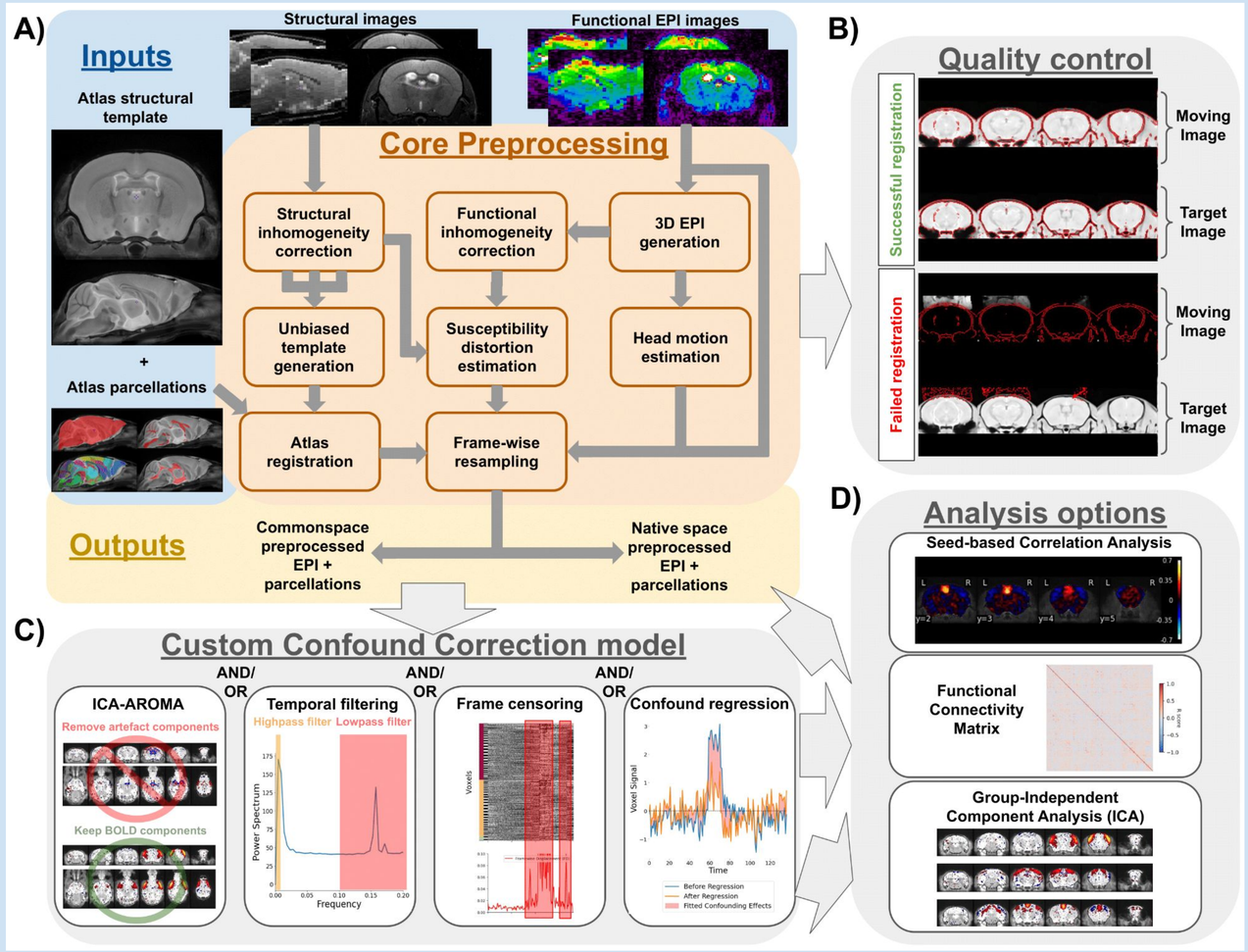
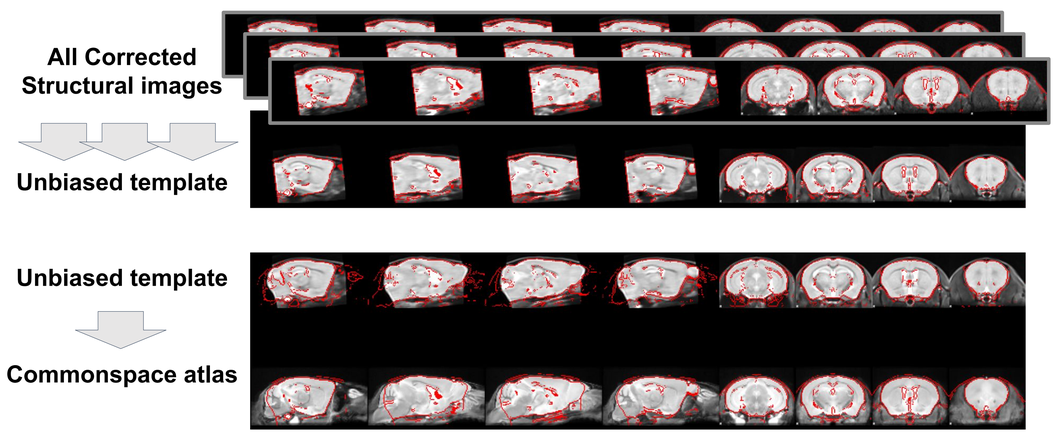
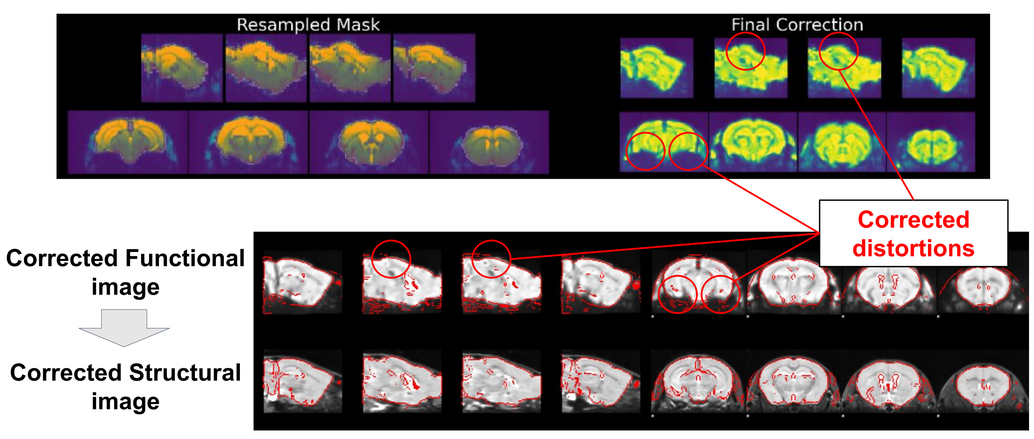


Figure 1: RABIES allows the preprocessing, quality control, confound correction and analysis of rodent fMRI datasets. **A)** Schematic organization of the preprocessing pipeline. RABIES takes as inputs a dataset of EPI functional scans along with their structural scan (optional) in BIDS format, together with an external reference structural atlas containing anatomical masks and labels. The core preprocessing architecture conducts commonspace alignment, head motion realignment and susceptibility distortion correction. **B)** RABIES generates automatically PNG images allowing the visual quality control (QC) of each failure-prone preprocessing step. **C)** Following preprocessing, an array of confound correction strategies are available and can be customized according to user needs. **D)** After applying confound correction, a final workflow is made available to conduct basic resting state analysis.


All Corrected
Structural images
Unbiased template
Unbiased template
Commonspace atlas


Resampled Mask
Final Correction
Corrected
distortions
Corrected Functional
image
Corrected Structural
image