RESTplus: a toolkit for functional magnetic resonance imaging data processing

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Background: In parallel with the increasingly use of resting-state fMRI (RS-fMRI) in basic and clinical neuroscience research (Lee et al. 2013) and the rapid development of data analysis methods in the field, there is an urgent need for a comprehensive and user-friendly software package to facilitate data analysis of RS-fMRI. We released such a toolbox, named “RESting-state fMRI data analysis Toolkit (REST)” (Song et al. 2011) in 2007, which has been widely utilized by a large and accumulating user community and cited in hundreds of publications, but the current version lacks a user-friendly pipeline and it hasn’t been updated with the most recently proposed RS-fMRI metrics. To address these issues and others requested by the user community, we here introduced a new version of REST, named RESTplus.

Methods: RESTplus is built based on REST (Song et al. 2011), DPARSF (Yan et al. 2010), and SPM (Friston et al. 1995). The main updates include 1) adding graphical user interfaces (GUI) for all major function modules; 2) providing functions for calculating more RS-fMRI metrics (e.g., percent amplitude of fluctuation, PerAF); and 3) integrating a plugin for processing arterial spin labeling (ASL)-based perfusion MRI data using ASLtbx (Wang et al. 2008) because ASL is another important modality which has increasingly been used in the resting-state fMRI field.

Results: The main modules in RESTplus include: preprocessing, statistical analysis, utilities, and image viewer. The pipeline consists of all preprocessing steps and RS-fMRI metrics used in the mainstream RS-fMRI literature. These processing steps can be toggled in the GUI and will be automatically conducted (batch mode allowed as well). Statistical analysis module provides standard statistical analysis options. The results can be assessed and visualized using the image viewer. Utilities module contains miscellaneous image processing tools. The ASLtbx plugin contains the latest version of ASLtbx with a pipelined GUI.

Conclusions: RESTplus is a user-friendly and comprehensive collection of neuroimaging data processing tools, allowing users to process fMRI data and ASL data with not only a pipelined GUI mode but also a command-line-based mode. Brain image statistical analyses and result viewing are convenient if using RESTplus.