Neuroconductor: An R Platform for Medical Imaging Analysis

John Muschelli[1], Jean-Philippe Fortin[2], Adrian Gherman[1],Brian Avants[2], Brandon Whitcher[3,4], Jonathan D. Clayden[5], Brian S. Caffo[1], Ciprian M. Crainiceanu[1]
[1]Johns Hopkins Bloomberg School of Public Health, Department of Biostatistics
[2]Perelman School of Medicine, University of Pennsylvania [3]Klarismo Ltd, London, UK
[4]Department of Mathematics, Imperial College London, London, UK
[5]Institute of Child Health, Developmental Imaging and Biophysics Section, University College London, UK

What is Neuroconductor?

Neuroconductor is a a centralized repository of R software dedicated to medical image analysis.

Goals of Neuroconductor

- Disseminate quickly software updates
- Educate a large, diverse community of scientists using detailed tutorials and short courses
- Ensure quality via automatic and manual quality controls
- Promote the reproducibility of image data analysis

Benefits of Imaging in R

Allow medical imaging to use all R has to offer:

- Statistics and Machine Learning
- Package versioning, testing, and distribution
- Reproducibile reports and analyses (knitr and rmarkdown)
- Shiny applications for the web

Potential Downsides to Neuroconductor

- More control over the workflow = more work (e.g. for statisticians)
- Users need external software (versions/installation)
- No control over external software
  - if maintainer changes something, not much recourse
- Need the content (buy-in from the imaging/R communities)

References

[1] Dirk Eddelbuettel et al. "Rcpp: Seamless R and C++ integration". In: *Journal of Statistical Software* 40.8 (2011), pp. 1–18.
[2] Bennett A Landman et al. "Multi-parametric neuroimaging reproducibility: a 3-T resource study". In: *Neuroimage* 54.4 (2011), pp. 2854–2866.
[3] Bennett Allan Landman et al. *MICCAI 2012 Workshop on Multi-Atlas Labeling*. CreateSpace Independent Publishing Platform, 2012.

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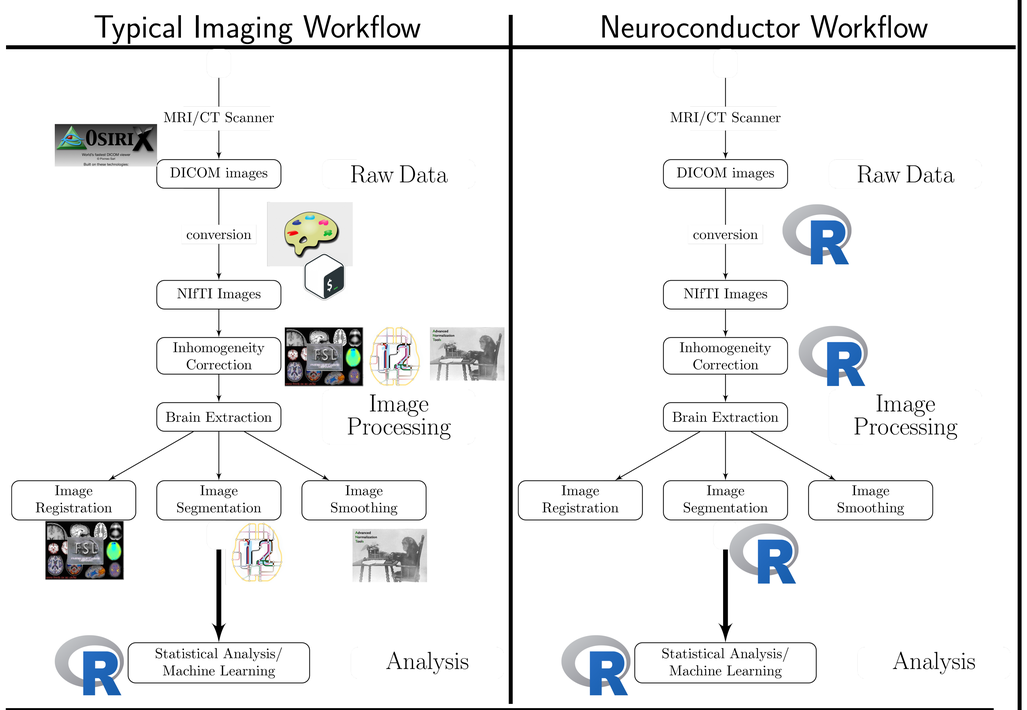
Example Imaging Workflow



bash - shell scripting is usually required for command-line tools or pipelining

FSL (FMRIB Software Library) - suite of neuroimaging analysis tools

ANTs (Advanced Normalization Tools) - state-of-the-art tools for neuroimaging analysis

MRIcroGL - imaging analysis suite, with dcm2nii - DICOM to NIfTI software

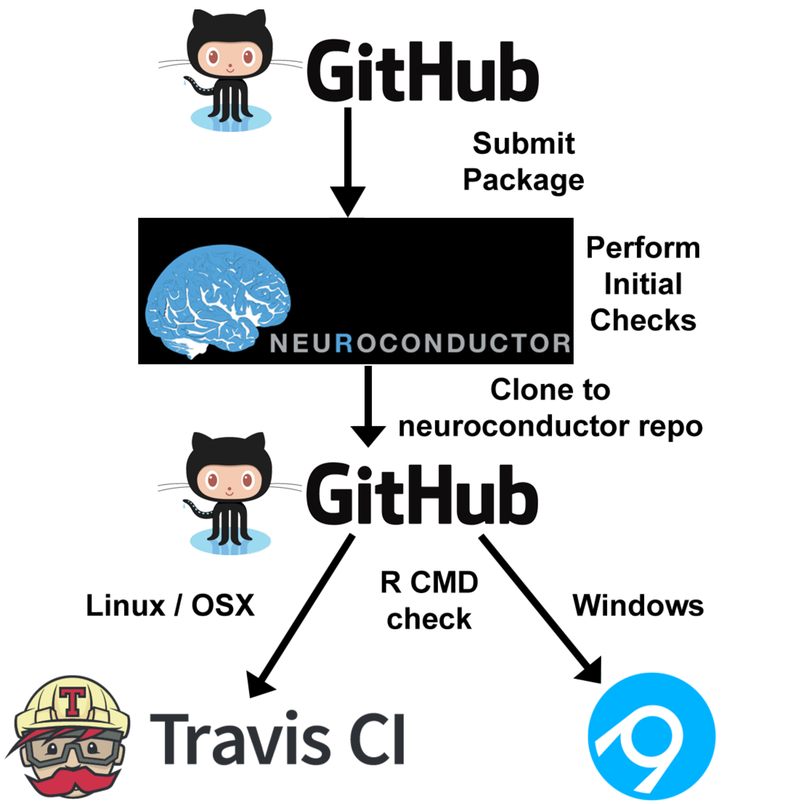
OsiriX - standalone DICOM viewer

SPM 12 - statistical parametric mapping, requires MATLAB (Mathworks, Natick, Massachusetts, USA) - analysis tools for PET/SPECT/fMRI

Current Neuroconductor Packages

oro.nifti	read/write NIfTI Images
RNifti	read/write NIfTI Images
dcm2niir	convert from DICOM to NIfTI (using dcm2niix binary)
divest	convert from DICOM to NIfTI (using Rcpp) [1]
fslr	FSL port - preprocessing/registration/image operations
freesurfer	Freesurfer port - image registration/segmentation
ANTsR	implements ANTs in Rcpp - preprocessing/registration/image operations
kirby21	[2]
EveTemplate	
malf.templates	Templates [3] for Multi-Atlas Label Fusion (MALF) and Skull Stripping

Neuroconductor Developer Workflow



GitHub - a online hosting service of git repositories. All Neuroconductor packages are hosted on GitHub.

Before uploading to GitHub, checks are performed, a confirmatory email is sent (reduce spam), and Travis/Appveyor configuration files are added

Travis CI (continuous integration) - an online service of Linux/Mac OSX virtual machines that build and check packages

AppVeyor - a similar CI service that builds and checks packages on Windows

Conclusions