Resting State Analysis

Pre-processing

Caveats & Kvetches

Tools

Self-Referencing

- Basic issue: No external information to “tie down” the analysis
  - No task timing, no behavior measurements
- Can only reference data to itself
- Which means that statistical inference is tricky
- Artifacts can reduce ***and/or*** increase inter-regional correlations of RS data

Issues to Suffer With

- Spikes in the data
- Motion artifacts, even after image registration
- Physiological signals
- Long-term drifts = low frequency noise
- Rapid signal changes = high frequency noise
  - BOLD effect is slow, so signal changes faster than time scale of (say) 10 seconds aren't (mostly) BOLD

Solutions via Pre-Processing

- Despiking the data
- Slice timing correction
- Motion correction
- Spatial normalization, alignment of EPI to anatomy, segmentation of anatomy
- Extraction of tissue-based regressors of no interest [e.g., **ANATICOR** (HJ Jo et alii)]
  - Spatial blurring, if any, comes ***AFTER*** this step
- Motion censoring + Nuisance regression [via **RetroTS**] + Bandpass filtering [all in one step]

Things We Really Don't Like

- Global Signal Regression (GSR)
  - Its effects on inter-regional correlations are unquantifiable, spatially variable, and can significantly differ between subject groups
  - There is a strong interaction between GSR and subject head motion that is also confusing
- Poor software implementations of the pre-processing steps
  - and poorly written Methods sections of papers
- Spatial blurring before tissue-based regressor extraction!

RS-FMRI: Still Condensing from the Primordial Quark-Gluon Plasma

- Data acquisition and processing for RS-FMRI is still unsettled
  - **MUCH** more so than for task-based FMRI
- How to deal with removal of various artifacts is still a subject for R&D
- How to interpret the results is also up in the air
- Convergence of results from different strains of evidence, and/or from different types of analyses is a good thing

Tools in AFNI - 1

- **afni_proc.py** will do the pre-processing steps as we currently recommend
  - Results are ready-to-analyze individual subject time series datasets, hopefully cleaned up, and in standard (atlas/template) space
- **3dTcorrMap** = compute average correlation of every voxel with every other voxel in the brain
  - AKA “overall connectedness” of each voxel
- **3dTcorr1D** = compute correlation of every voxel time series in a dataset with external time series in a 1D text file

Tools in AFNI - 2

- **3dAutoTcorrelate** = compute and save correlation of every voxel time series with every other voxel time series
  - Output file can be **HUMUNGOLIOUS**
- **AFNI InstaCorr** = interactive tool for testing one dataset with seed-based correlation
- **3dGroupInCorr** = interactive tool for testing 1 or 2 groups of datasets with seed-based correlation

Paper from NIMH

- Illustrates how to process and think about RS-FMRI data

Fractionation of social brain circuits in autism spectrum disorders

SJ Gotts, WK Simmons, LA Milbury, GL Wallace, RW Cox, and A Martin

Brain **135:2711-2725 (2012)**

doi: 10.1093/brain/aws160