What's New in AFNI-Land

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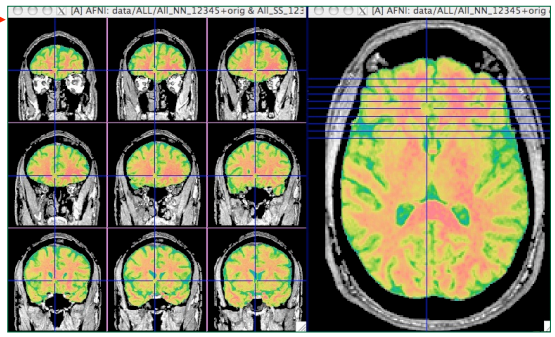
Skull Stripping

- Robust extensions to **FSL's BET** algorithm (expanding surface from center), including
  - expansion driven by data inside and outside the surface
  - special care to avoid eyes and ventricles
  - a set of operations to avoid the clipping of certain brain areas and reduce leakage into the skull in heavily shaded data
  - two additional processing stages to ensure convergence and reduction of clipped areas
  - use of 3D edge detection
  - special options for **monkey brain** processing (*cf.* Tuesday-PM poster #428)
- Many options to customize processing for difficult cases
- Output surface models of skull (inner and outer) — for MEG and EEG source localization analyses
- Can send evolving surface and images to **`AFNI`** for visualization of progress
  - Helps to see where problems lurk
  - Recommendation: **always look at results** of a skull-stripping (or other segmentation) program!



Anatomy Toolbox Datasets and `whereami` Program

- Now incorporates cytoarchitectonic atlas datasets from Amunts, Eickhoff, Zilles, *et alii*
- Interactive navigation aid illustrated to left (*i.e.*, best guesses as to where the crosshairs are)
- Scriptable **`whereami`** program can be used to generate the following
  - Tabular output from lists of coordinates (*e.g*, from activated cluster centroids à la **`3dclust`**)
  - ROI masks generated (in memory) from particular atlas datasets:
    e.g., "**`CA_N27_ML:left:hippo`**" specifies left hippocampus from the CA_N27_ML atlas
  - Determine percent overlap of activated clusters with labeled regions, as in this report:
- Atlas files included with AFNI source code and binary distributions

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Intersection of ROI (valued 2) with atlas CA_N27_ML (sb0):
  26.0 % overlap with Right Rolandic Operculum, code 18
  24.5 % overlap with Right Superior Temporal Gyrus, code 82
  24.1 % overlap with Right Insula Lobe, code 30
   9.8 % overlap with Right Heschls Gyrus, code 80
   4.3 % overlap with Right Putamen, code 74
   0.0 % overlap with Right Middle Temporal Gyrus, code 86
   0.0 % overlap with Right SupraMarginal Gyrus, code 64
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  88.7 % of cluster accounted for.
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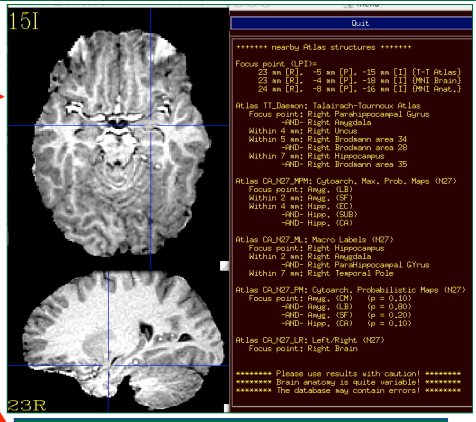


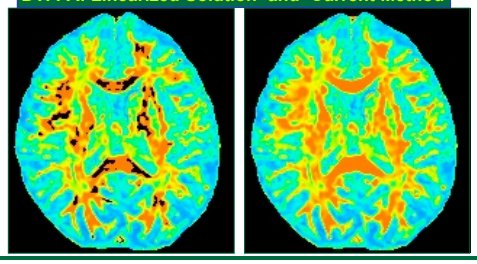
Diffusion Tensor Estimation

- Program **`3dDWItoDT`** provides an **efficient**, **robust**, **nonlinear**, and **guaranteed positive definite** method for estimating the diffusion tensor from DWI datasets
  - Modified gradient descent to solve $I^{(q)} = J\exp(-\mathbf{b}^{(q)} \bullet \mathbf{D}) + \text{noise}^{(q)}$ via nonlinear weighted least-squares
    - Fastest descent direction chosen that guarantees $\mathbf{D}$ remains positive definite at all times
  - CPU time on a $256 \times 256 \times 54$ (voxels) $\times 33$ (directions) dataset (Intel iMac):
    - **180 s** for a fully nonlinear solution, vs **20 s** for a linear least squares solution

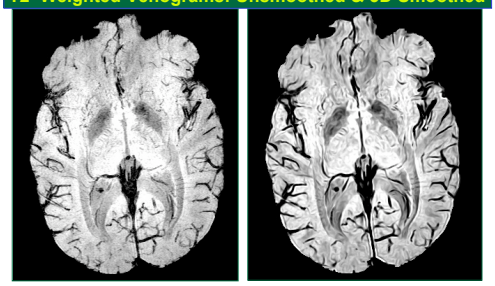
Nonlinear Anisotropic Smoothing

- Program **`3danisosmooth`** does 2D and 3D nonlinear anisotropic diffusive smoothing on collections of 3D volumes simultaneously
  - Can be used with DWI data prior to DTI estimation (smoothing depends on structure of all images)
  - Useful for enhancing fine structures without blurring

DTI FA: Linearized Solution and Current Method



T2* Weighted Venograms: Unsmoothed & 3D Smoothed



Surface-Based FMRI Data Analyses

- After volume registration, some or all of GLM analysis stream can take place on cortical surface models:

`3dSurf2Vol`	→	**`SurfSmooth`**	→	**`3dDeconvolve`**	→	**`3dANOVAx`**
Project EPI time series to surface (average across cortical thickness)		Smooth data along the surface only		Linear time series analysis as usual		Group Analysis as usual

- Cortical surface models can be input from **`FreeSurfer`**, **`Caret`**, **`BrainVoyager`**, and **`CRUISE`**
- For comparing data mapped to surface models with different topologies, 2 approaches are possible:
  - Create standardized surface models, with a fixed topology, from the arbitrary triangulation models, using program **`MapIcosahedron`**; each surface node & triangle then corresponds between subjects
  - Interpolate data between topologically different surfaces using program **`SurfToSurf`**
- **ROIs** can be drawn manually on a surface model using the interactive surface tools in **`SUMA`**
  - or mapped from volumetric ROIs (*e.g.*, from the Anatomy Toolbox datasets) to the surface using **`AFNI`**
  - or generate contiguous clusters of supra-threshold surface nodes using **`SurfClust`**
- **In progress:** Landmark-based warping of surfaces to improve inter-subject alignment

Miscellaneous Stuff

- Program **`Dimon`** reads DICOM files, runs **`to3d`** to create AFNI datasets (optionally, sends images directly into **`AFNI`** for realtime display and registration)
- NIfTI-1.1 format supported for input and output in all AFNI programs
- Program **`3dInvFMRI`** computes stimulus time series that best fit a given spatial activation map
- Can script many **`AFNI`** interactive operations using the new "**`-com`**" command line option
  - *e.g.*, open image window, change colormap, save image to JPEG file (*cf.* Monday-PM poster #568)

See also

- **Monday-PM poster #568** by Saad et alii
- **Tuesday-PM poster #428** by Christidis *et alii*
- Download AFNI from
  `http://afni.nimh.nih.gov/afni`
- Download PDF copies of our posters from
  `http://afni.nimh.nih.gov/sscc/posters`

Take a Handout

- Tips for the interactive **`AFNI`** GUI!
- Test your knowledge of **`AFNI`**'s powers!