AFNI Jewel Box
AKA Tool Box, Treasure Chest or Miscellaneous Tools

- There are more than 300 AFNI programs, plugins, and scripts
- Most come with help output or menus that provide a reminder about their usage; for most programs, the output of \texttt{-help} is the most up-to-date documentation. Some actually have more extensive documentation including white papers, publications and presentations available through website.
Dataset Creation and Conversion

- to3d
  - 3dcopy
    - 3dAFNIto3D
    - 3dAFNItoANALYZE
    - 3dAFNItoMINC
    - 3dAFNItoRaw
    - 3dAFNItoNIFTI
    - 3dANALYZEtoAFNI
    - 3dMINCtoAFNI
    - 3dBRAIN_VOYAGERtoAFNI
    - 3dCRUISEtoAFNI
  - 3dThreetoRGB
    - 3dcalc -prefix DTIevec -a 'DTI+orig.[9..11]' -c 'DTI00+orig.[18]' \ -expr 'c*STEP(c- 0.25)*255*ABS(a)'
    - 3dThreetoRGB -prefix DTIRGB -anat 'DTIevec+orig.[0]' \ 'DTIevec+orig.[1]' 'DTIevec+orig.[2]'

- from3d
  - from3d -prefix xxx -raw -input anat+orig
  - from3d -prefix xxx -raw -input anat+orig
  - For a single brick dataset with 256x256x41 slices outputs 41 256x256 image files that are each 131,072 bytes in length with the names xxx.001 through xxx.041

- Discussed in other lectures
  - Discussed here
• **Auxiliary Programs for Dataset Creation from Images**

  **Ifile**  
  Read GE realtime EPI files and runs to3d

  **Imon**  
  Read GE realtime EPI files as they are created

  **Dimon**  
  Read DICOM files as they are created, organize DICOM files, send to AFNI GUI in realtime.

  Dimon -infile_prefix run1/image -dicom_org –GERT_reco -quit

  **rtfeedme**  
  Send AFNI datasets to AFNI realtime plugin (afni –rt) and send DRIVE_AFN1 commands

  **plugin: RT Options**  
  Control options for AFNI-side realtime image input

  **abut**  
  Create zero-filled slices to put into dataset gaps
Calculators

➢ **ccalc**  Command line calculator

```
ccalc '3 * 4'
12.000000
```

```
ccalc -form '********\n%6.4f%%\n********' -eval '100*328/457'

********
0.7177%
********
```

➢ **1deval**  1D calculator (like 3dcalc for 1D files)

Example: Calculate simple first derivative numerically for a column of numbers

```
1deval -a data.1D'[1]{0..98}' -b data.1D'[1]{1..99}' -expr '(b-a)/2'
```
- 3dcalc  Voxel-by-voxel general purpose calculator for 3D datasets
   Useful for combining ROI masks in various ways
   Useful for forming ‘conjunction tests’, and many other voxel-wise operations
   3dcalc -prefix mask_17.2 -a stats+orig'[2]' -expr 'ispositive(a-17.2)'
   3dcalc -prefix stat_mask -a stats+orig'[2]' -b mask+orig -expr 'a*ispositive(b)'

   Example: convert dataset from short (16-bit signed integer) to floating point
   3dcalc -prefix floatdata -a shortdata+orig -datum float -expr 'a'

   Example: calculate ROI statistics only on a specific slice (slice 17)
   3dROIstats -mask '3dcalc(-a func_slim+orig[0] -expr equals(k,17))'
   func_slim+orig

- 1dmatcalc  Matrix calculator using 1D files
   Useful for operations on vectors or matrices. Uses reverse polish notation stack oriented interface. Operations include matrix multiplication, addition, subtraction, pseudo-inverse, transpose, read and write.
   1dmatcalc "&read(V.1D) &read(U.1D) &transp * &write(VUT.1D)"
   1dmatcalc "&read(3cols.1D) 2 * &write(-)"

- 3dmatcalc  "Applies" matrix to datasets
   Multiplies matrix (m x n) by a vector of n voxels through time of 3D+time dataset creating a new dataset m sub-bricks long
Example: make right and left hemisphere masks from with aligned volumes

```
3dautomask -prefix M epi+orig
3dcalc -a M+orig -dicom -expr 'ispositive(x-3.5)' -prefix Mright
3dcalc -a M+orig -dicom -expr 'isnegative(x-3.5)' -prefix Mleft
```

Example: temporal median smoothing

```
3dcalc -a fred+orig -b 'a[0,0,0,1]' -c 'a[0,0,0,-1]' -expr 'median(a,b,c)'
```

Example: create dataset following a 2D cosine periodic function centered around the center of each slice

```
3dcalc -prefix cos0.4 -a 256blank+orig. -expr 'cos(PI * 0.4 * sqrt( (x * x)+ (y * y)) )'
```
Simple statistics on datasets

- **3dTstat**: Various statistics of multi-brick datasets, voxel-by-voxel, across sub-bricks
- **3dMean**: Average datasets together, voxel-by-voxel, across datasets
  - **3dLocalstat**: Find simple statistical values for “neighborhoods” around each voxel
    
    ```
    3dLocalstat -nbhd 'rect(0,0,1)' -stat min -prefix 3dgrass_minip
    3dgrass_uni+orig
    ```
  - **3dBrickStat**: Return simple statistical values of voxel values (max, min, count) over a whole dataset (results only, useful for scripting)
    
    ```
    3dBrickStat -slow -min -max "DT+orig[18]"
    3dcalc -prefix RGB3EVA255scaled -a 'DT+orig.[9..11]' -c 'DT+orig.[18]' -expr 'c*255*ABS(a)/`3dMax "DT+orig[18]"`
    ```
- **3dExtrema**, **3dMaxima**, **Maxima plug-in**: Find coordinates of all local maxima (or minima) across sub-bricks and return list or mask dataset for those voxels
Image Filters

- **Smoothing and filtering datasets**
  - **3dmerge** Various spatial filters, thresholds, clustering and averaging
    - `3dmerge -1filter_aver 8 -prefix funcFaver8 funcslim+orig`
  - **3danisosmooth** Anisotropical smoothing (preserves edges)
    - `3danisosmooth -iters 4 -matchorig -3D -prefix anat_as -viewer anat+orig`
  - **3dWinsor** Nonlinear order statistics filter for spatial smoothing
  - **3dUniformize** Correct for image intensity non-uniformity in anatomical datasets

![Original](image1.png)
![3dmerge -1filter_aver 8](image2.png)
![3dmerge -1blur_fwhm 8](image3.png)
Spatial sharpening filter options

Original Image

3danisossmooth

Winsor-9 filter

Sharpen-4 filter

Display options
3danisosmooth - DWI/DT data

Fractional Anisotropy (FA) maps (original, with added noise from DWI data, 3danisosmooth)
3D+time Pre-Processing Programs

- **3dTshift**  
  Shift slices to a common time origin (temporal interpolation)

- **3dDespike**  
  Remove spikes from voxel time series

- **3dDetrend**  
  Remove trends from voxel time series

- **3dFourier**  
  FFT-based lowpass and highpass filtering

- **3dTsmooth**  
  Smooth time series in the time domain

![Graph](image)

- black - original
- red - 3dTsmooth –med
- blue - 3dFourier –highpass 0.01
3D+time Analysis Programs

**Regression of individual datasets**

- **3dDeconvolve**  Multiple linear regression and deconvolution
  Supercedes 3dfim, 3dfim+

  **Plugin:** Deconvolution Interactive deconvolution

- **3dNLfim**  Nonlinear regression

  **Plugins:** Nlfit & Nlerr

  Square wave fit

- **3dTcorrelate**  Correlate two input datasets, voxel-by-voxel

- **3dAutoTcorrelate**  Correlate each voxel with every other voxel

- **3dpc**  Principal component analysis

- **3ddelay**  Estimate delay response between a time series and a reference time series

**Model 1D Time Series Generators**

- **sqwave**  Generate a square wave (on / off cycles)

- **waver**  Generate hemodynamic responses to stimulus time series
• **Dataset Histogram Programs**

  ➢ **3dAnhist**  
  Create and plot “Anatomy” histogram of dataset, print peaks

  3dAnhist -h 3dgrass+orig
Dataset Histogram Programs

- **3dhistog**  
  Create histogram of dataset to a file

  ```
  % 3dhistog -nbin 0 zork+orig
  #Magnitude Freq Cum Freq
  0.000000 77821 77821
  1.000000 1 77822
  2.000000 1 77823
  3.000000 0 77823
  4.000000 1 77824
  ---
  ```

- **plugin: Histogram**  
  Interactively graphs histogram of a dataset (or ROI)
ROI Generation and Usage Programs

- **plugin: Draw Dataset**  Manually draw ROI mask datasets
- **3dAutomask**  Generate a brain-only mask from an EPI dataset
- **3dmaskave**  Calculate dataset values averaged over an ROI
- **3dROIstats**  Calculate dataset values from multiple ROIs
- **3dmaskdump**  Output voxel values in an ROI or a dataset
  
  3dmaskdump -ibox 32 18 10 -noijk > voxelvstime.1D
  
  1dtranspose voxelvstime.1D
  
  1dplot voxelvstime.1D &

- **3dUndump**  Input text values into a dataset (inverse of 3dmaskdump)
- **3dGetrow**  Output voxel values for a row/column in x,y,z space
ROI Generation and Usage Programs (Continued)

3dOverlap  
Create mask that is overlap of nonzero voxels from multiple datasets

3dfractionize  
Resample a mask dataset to a different resolution

whereami  
get atlas region name for coordinates (now vice-versa too)

whereami -13 68 -11 anat+tlrc
+++++++ nearby Atlas structures ++++++

Focus point (LPI)=
13 mm [R], -68 mm [P], -11 mm [I] {T-T Atlas}
13 mm [R], -69 mm [P], -17 mm [I] {MNI Brain}
14 mm [R], -77 mm [P], -7 mm [I] {MNI Anat.}

Atlas TT_Daemon: Talairach-Tournoux Atlas
Focus point: Left Declive
Within 1 mm: Left Culmen
Within 5 mm: Left Lingual Gyrus
-AND- Left Brodmann area 18
Within 6 mm: Left Brodmann area 19
Within 7 mm: Left Fusiform Gyrus
Dataset File Utilities

• **3dinfo**

  Print out information from the header

  Example from command line: `3dinfo astrip+orig`

  Example from afni GUI: Define Datamode → Misc → Anat

  **Info**

  Dataset File: astrip+orig
  Identifier Code: XYZ_8qmBAapL9YwE3I Creation Date: Wed Jun 9 11:54:12
  2004
  Dataset Type: Spoiled GRASS (-spgr)
  Byte Order: MSB_FIRST [this CPU native = LSB_FIRST]
  Data Axes Orientation:
  first (x) = Anterior-to-Posterior
  second (y) = Superior-to-Inferior
  third (z) = Left-to-Right [-orient ASL]
  voxels]
  A-to-P extent: -119.531 [A] -to- 119.531 [P] -step- 0.938 mm[256
  voxels]
  I-to-S extent: -119.531 [I] -to- 119.531 [S] -step- 0.938 mm[256
  voxels]
  R-to-L center: -0.200 [R]
  A-to-P center: 0.000 [P]
  I-to-S center: -0.000 [I]
  Number of values stored at each pixel = 1
  -- At sub-brick #0 ‘#0’ datum type is short: 0 to
  733

  ---HISTORY---
  [cox@elrond: Mon Jun 14 16:04:31 2004] 3dIntracranial -min_val 30
  -anat fred+orig -prefix astrip
Dataset File Utilities (continued)

- **3dAttribute**
  - Print out a single or all header attributes
    - 3dAttribute -name ORIGIN epi_r1+orig
      - ORIGIN = 118.125 118.125 -69
    - 3dAttribute -name BRICK_STATS 3dgrass_uni+orig.
      - BRICK_STATS = 0 4480

- **3dnewid**
  - Assign a new ID code to a dataset

- **3drefit**
  - Lets you change attributes in a dataset header
    - Example: change orientation code and location of origin
      - 3drefit -orient LPI -zorigin 30 fred+orig
    - Example: anonymize dataset
      - 3drefit -denote fred+orig

- **3dNotes**
  - Lets you put text notes into a dataset header

**Plugin:** Dataset NOTES  
Interactive header notes editor

**nifti_tool**  
Displays, modifies, copies nifti structures in datasets
• Programs for Changing Dataset Spatial Structure
  
  3daxialize  Rewrite dataset with slices in different direction
  3dresample  Rewrite dataset in new orientation, with new voxel size
  3dLRflip    Flip dataset Left to Right

• Programs for Assembling Sub-bricks into 4D Datasets
  
  3dTcat       Assemble a 3D+time dataset from multiple input sub-bricks
  3dbucket    Assemble a bucket dataset from multiple input sub-bricks

• Programs for Changing Slice Structure
  
  3dZcat       Glue multiple sub-bricks together along the z-axis
  3dZcutup     Cut slices out of a dataset to make a ‘thinner’ dataset
  3dZeropad    Add zero slices around the edges of a dataset
                Can also cut planes off edges of dataset to deal with a smaller dataset

  3dZeropad  -R 4  -L 6  -I 2  -S 3  -prefix fred_pad
              fred+orig

  3dZregrid   Interpolate a dataset to a different slice thickness
• Spatial Transformations of Dataset Geometry
  3drotate  Rigid body rotation of dataset in 3D
  3dWarp   Non-rigid transformation of 3D coordinates
  3dAnatNudge Try to align EPI and structural volumes automatically
plugin: Nudge Dataset Align EPI and structural volumes manually
  3dTagalign Align datasets by matching manually placed ‘tags’
plugin: Edit Tagset Place ‘tags’ in a dataset interactively
  o adwarp Transform dataset using warp from dataset header
  Vecwarp Transform 3-vectors using warp from dataset header
• Dataset File Manipulation
  3dcopy Copy a dataset to make new files
  3drename Rename dataset files
  3ddup Make an ‘empty’ duplicate (warp-on-demand) of a dataset
Volume Segmentation Tools

- **3dIntracranial** -- Strip the scalp and other non-brain tissue from a high-resolution T1-weighted dataset
  
  ```
  3dIntracranial -anat fred+orig -prefix fred_strip
  ```

- **3dSkullStrip** -- Improves upon 3dIntracranial, creates a brain-only mask
  
  ```
  3dSkullStrip -input fred_anat+orig -prefix fred_strip \
  -no_avoid_eyes -niter 750 -ld 50
  ```

Also GyrusFinder plug-in, 3dAnhist, 3dClipLevel, 3dAutomask, 3dclust, 3dmerge, 3dUniformize
Computation of Various Numbers from Datasets

- **3ddot**: Dot product (correlation coefficient) of 2 sub-bricks
- **3dclust**: Find connected clusters of nonzero voxels
- **3dFWHM**: Estimate Full Width Half Max of dataset spatial correlation

Simulated Dataset Generators

- **3dTSgen**: Generate 3D+time dataset from 1D model and noise
- **3dClustSim**: Simulate datasets and estimate statistical power (Monte Carlo multiple comparison correction)
- **3dConvolve**: Simulate datasets via convolution
- **3dInvFMRI**: Compute stimulus time series given activation map and 3D+time dataset

Programs for Dealing with 1D Time Series

- **1dcat**: Concatenate columns from multiple 1D files row by row
- **1dplot**: Graph the columns as the y-values in a graph
- **1dtranspose**: Transpose (interchange) rows and columns
Spatial Utilities

- **3dclust** -- Find clusters of “active” voxels and print out a report about them
  - “Active” means nonzero (survives thresholding operation)
  - Clusters are defined by a connectivity radius parameter $r_{mm}$:
    
    - $r_{mm} = 1.01$ mm
      clusters nearest neighbors
    
    - $r_{mm} = 1.415$ mm ($1.734$ -3D)
      clusters next nearest neighbors
    
    - $r_{mm} = 2.01$ mm
      clusters $2^{nd}$ next nearest neighbors

    Clustering actually takes place in 3D

  - Clustering starts by finding some nonzero voxel
  - All nonzero voxels closer than $r_{mm}$ millimeters (center-to-center distance) to the given voxel are included in the cluster
  - Cluster then grows outwards from all newly included voxels, using $r_{mm}$ again
Clustering actually takes place in 3D:

- Assume cubical voxels with grid size $L$ mm

  - $L < r_{mm} < \sqrt{2} L \Rightarrow$ connect voxels that share a common face
  - $\sqrt{2} L < r_{mm} < \sqrt{3} L \Rightarrow$ connect voxels that share a common edge
  - $\sqrt{3} L < r_{mm} < 2L \Rightarrow$ connect voxels that share a corner

- Larger values of $r_{mm}$ will jump over zero voxels

You can override actual voxel size (which may not be cubical) by using the `-dxyz=1` command line switch, which then pretends that voxel size $L=1$

Sample report: `3dclust -1thresh 0.47 7 600 fred_epi+orig`

---

Cluster report for file `fred_epi+orig`

[Connectivity radius = 7.00 mm Volume threshold = 600.00 ]

[Single voxel volume = 98.4 (microliters) ]

[Voxel datum type = short ]

[Voxel dimensions = 3.750 mm x 3.750 mm x 7.000 mm ]

Mean and SEM based on Absolute Value of voxel intensities:

<table>
<thead>
<tr>
<th>Volume</th>
<th>CM RL</th>
<th>CM AP</th>
<th>CM IS</th>
<th>minRL</th>
<th>maxRL</th>
<th>minAP</th>
<th>maxAP</th>
<th>minIS</th>
<th>maxIS</th>
<th>Mean</th>
<th>SEM</th>
<th>Max Int</th>
<th>MI RL</th>
<th>MI AP</th>
<th>MI IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3839</td>
<td>2.3</td>
<td>-15.3</td>
<td>4.4</td>
<td>-11.0</td>
<td>10.0</td>
<td>-28.1</td>
<td>-5.6</td>
<td>-9.4</td>
<td>20.6</td>
<td>0.0069</td>
<td>4.8e-04</td>
<td>0.0176</td>
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<td>-13.1</td>
<td>5.6</td>
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<td>2067</td>
<td>16.0</td>
<td>56.8</td>
<td>9.4</td>
<td>3.0</td>
<td>24.0</td>
<td>39.4</td>
<td>65.6</td>
<td>1.9</td>
<td>16.9</td>
<td>0.0059</td>
<td>4.3e-04</td>
<td>0.0107</td>
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<td>5.3</td>
<td>0.2</td>
<td>24.0</td>
<td>52.0</td>
<td>-13.1</td>
<td>-1.9</td>
<td>-9.4</td>
<td>5.6</td>
<td>0.006</td>
<td>5.1e-04</td>
<td>0.0111</td>
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<td>1.9</td>
</tr>
<tr>
<td>1575</td>
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<td>-36.7</td>
<td>4.5</td>
<td>-25.0</td>
<td>-18.0</td>
<td>-43.1</td>
<td>-28.1</td>
<td>-9.4</td>
<td>13.1</td>
<td>0.0072</td>
<td>0.001</td>
<td>-0.0181</td>
<td>-18.0</td>
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<td>-31.7</td>
<td>-4.0</td>
<td>10.0</td>
<td>-69.4</td>
<td>-58.1</td>
<td>-39.4</td>
<td>-28.1</td>
<td>0.0109</td>
<td>0.001</td>
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<td>1.4</td>
<td>24.0</td>
<td>31.0</td>
<td>-35.6</td>
<td>-24.4</td>
<td>-9.4</td>
<td>9.4</td>
<td>0.0053</td>
<td>4.9e-04</td>
<td>0.0089</td>
<td>24.0</td>
<td>-35.6</td>
<td>5.6</td>
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<tr>
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<td>-50.9</td>
<td>0.6</td>
<td>-4.0</td>
<td>10.0</td>
<td>-54.4</td>
<td>-46.9</td>
<td>-13.1</td>
<td>5.6</td>
<td>0.0071</td>
<td>0.0011</td>
<td>0.0154</td>
<td>-4.0</td>
<td>50.6</td>
<td>5.6</td>
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<tr>
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<td>-28.8</td>
<td>-10.9</td>
<td>38.0</td>
<td>52.0</td>
<td>-31.9</td>
<td>-20.6</td>
<td>-13.1</td>
<td>-5.6</td>
<td>0.0059</td>
<td>7.7e-04</td>
<td>0.0096</td>
<td>38.0</td>
<td>-31.9</td>
<td>9.4</td>
</tr>
<tr>
<td>689</td>
<td>33.2</td>
<td>-4.7</td>
<td>17.8</td>
<td>31.0</td>
<td>38.0</td>
<td>-9.4</td>
<td>-1.9</td>
<td>13.1</td>
<td>24.4</td>
<td>0.0074</td>
<td>0.0011</td>
<td>0.0133</td>
<td>31.0</td>
<td>-1.9</td>
<td>20.6</td>
</tr>
</tbody>
</table>

- `-1thresh 0.47` = threshold to apply to dataset; $7 = r_{mm}$; $600 =$ volume of smallest cluster to report (in mm$^3$ = microliters)
• **Image Registration Programs**
  - 3dvolreg
    Volumetric registration (rigid body in 3D)
  - 3dWarpDrive
    Extension of 3dvolreg to include warping
  - 3dImReg
    Slice-by-slice registration (rigid body in 2D)

• **Miscellaneous File Manipulations**
  - 2swap
    Byte pair swap: ab  ba
  - 4swap
    Byte quad swap: abcd  dcba
  - 24swap
    Mixed 2 and 4 byte swaps in same file
  - strblast
    Find a string in a file and replace it with junk (anonymize)
  - byteorder
    Report the byteorder of the current CPU

• **Miscellaneous Utilities**
  - byteorder
    Report the byteorder of the current CPU
  - cdf
    Compute probabilities, thresholds for standard distributions
  - count
    Generate numbered strings for command line scripts

• **Image File Header Printouts**
  - dicom_hdr
    Print information from a DICOM file
  - ge_header
    Print information from a GE I. file
  - mayo_analyze
    Print information from an ANALYZE .hdr file
  - siemens_vision
    Print information from a Siemens Vision .ima file
Miscellaneous Visualization Tools

- **aiv**  
  AFNI Image Viewer program
  
aiv ~/abin/splash_earth.jpg &

- plugin: **Render**[new]  
  Interactive volume rendering

- plugin: **Dataset**#N  
  Graph extra dataset time series in AFNI graph viewer
## Group Dataset Statistical Analysis Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3dttest</td>
<td>Paired and unpaired t-tests</td>
</tr>
<tr>
<td>3dANOVA</td>
<td>1-way ANOVA (fixed effects)</td>
</tr>
<tr>
<td>3dANOVA2</td>
<td>2-way ANOVA (fixed, random, mixed effects)</td>
</tr>
<tr>
<td>3dANOVA3</td>
<td>3-way ANOVA (fixed, random, mixed effects)</td>
</tr>
<tr>
<td>GroupAna</td>
<td>n-way ANOVA - 1 to 5 ways (Matlab script)</td>
</tr>
<tr>
<td>3dFriedman</td>
<td>Nonparametric Friedman test for randomized complete block design experiments</td>
</tr>
<tr>
<td>3dKruskalWallis</td>
<td>Nonparametric Kruskal-Wallis test for comparison of multiple treatments</td>
</tr>
<tr>
<td>3dWilcoxon</td>
<td>Nonparametric Wilcoxon test signed-rank test for paired comparisons of two samples</td>
</tr>
<tr>
<td>3dMannWhitney</td>
<td>Nonparametric 3dMannWhitney two-sample test</td>
</tr>
<tr>
<td>3dRegAna</td>
<td>Voxel-wise multiple linear regression group analysis</td>
</tr>
<tr>
<td>3dFDR</td>
<td>False Discovery Rate analysis for thresholding of voxelwise statistics</td>
</tr>
<tr>
<td>3dClustSim</td>
<td>Alpha probability simulations for Monte Carlo analysis of clusters</td>
</tr>
</tbody>
</table>
Diffusion Tensor Imaging (DTI) Programs

- **3dDWItoDT** -- For diffusion weighted image (DWI) data, calculate the diffusion tensor image (DTI) data.
  - Uses traditional linear or an iterative non-linear method to compute diffusion tensor.
  - Computes eigenvalues, eigenvectors, fractional anisotropy, mean diffusivity

- **3dTeig** -- From DTI data compute eigenvalues, eigenvectors and fractional anisotropy.

- **3dDTtoDWI** -- Compute diffusion weighted volumes based on the diffusion tensor and an ideal B0 volume with no gradient.
  - Useful for testing purposes only.

- **DTIStudioFibertoSegments** -- Takes output of fiber tracking from DTIStudio.
  - Popular DTI program from Johns Hopkins. Output can be displayed in SUMA.
Scripts

@SUMA_Make_Spec_FS – convert Freesurfer surfaces to SUMA spec files
@SUMA_Make_Spec_SF – convert SureFit surfaces to SUMA spec files
@auto_tlrc – automatic transformation of dataset to match Talairach template
@CommandGlobb – execute AFNI commands for multiple datasets
@make_stim_file – make stim file for 3dDeconvolve from user input or file
@2dwarper – sample script to align slices of a time series dataset
@GetAfniOrient – return orientation code for a dataset (e.g. RAI)
@UpdateAfni – sample script for updates (also AFNI_UPDATER)
Scripts (continued)

@4Daverage – sample script for calculating means of multiple datasets
@GetAfniPrefix - pull the prefix part of the name out of dataset
@VolCenter – return the center coordinate of a dataset
@AfniOrient2RAImap – return index map of the RAI directions
@GetAfniView – return view part of name of dataset
@align_partial_oblique – align a partial T1 dataset with a full dataset
@AfniOrientSign – code for orientation relative to RAI (1 1 1);
                   LPS (-1 -1 -1)
@NoExt – remove specified file extensions from end of filename
@Align_Centers - align centers of dataset(s) to a base dataset
@Purify_1D – extract columns from 1D files
Scripts (continued)

@Center_Distance – return distance between two centers
@RenamePanga – create AFNI datasets from GE realtime data
@clip_volume – crop or zero out parts of a volume
@CheckForAfniDset – check for existence of AFNI datasets
@SUMA_AlignToExperiment – align anatomical volume to experimental volume
@fix_FSSsphere – fix Freesurfer spherical surface
@DTI_studio_reposition – match DTIStudio analyze file format to parent AFNI dataset
@parse_afni_name – return the path, prefix, view and sub-brick selection from dataset name
@parse_name – return path, prefix and extension from any file name
@FromRAI – return equivalent other coordinates (e.g. LPS) given RAI coordinates
@ToRAI – return equivalent RAI coordinates
## Plug-ins

<table>
<thead>
<tr>
<th>Command</th>
<th>Action 1</th>
<th>Action 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>-- Cancel --</td>
<td>Dataset#2</td>
<td>maskcalc</td>
</tr>
<tr>
<td>2D Registration</td>
<td>Dataset#N</td>
<td>Maxima</td>
</tr>
<tr>
<td>3D Cluster</td>
<td>Deconvolution</td>
<td>NLfit &amp; NLerr</td>
</tr>
<tr>
<td>3D Correlation</td>
<td>Draw Dataset</td>
<td>Nudge Dataset</td>
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<tr>
<td>3D Dump98</td>
<td>Dset Zeropad</td>
<td>Permutation Test</td>
</tr>
<tr>
<td>3D Edit</td>
<td>Edit Tagset</td>
<td>Power Spectrum</td>
</tr>
<tr>
<td>3D Registration</td>
<td>Expr 0D</td>
<td>Render [new]</td>
</tr>
<tr>
<td>3D+t Extract</td>
<td>Fourier Stuff</td>
<td>Render Dataset</td>
</tr>
<tr>
<td>3D+t Statistic</td>
<td>Gyrus Finder</td>
<td>Reorder</td>
</tr>
<tr>
<td>4D Dump</td>
<td>Hemi-subtract</td>
<td>ROI Average</td>
</tr>
<tr>
<td>BRIK Compressor</td>
<td>Hilbert Delay98</td>
<td>ROI Plot</td>
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<tr>
<td>Coord Order</td>
<td>Histogram</td>
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<tr>
<td>Dataset Copy</td>
<td>Histogram: BFit</td>
<td>SingleTrial Avg</td>
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<tr>
<td>Dataset Dup</td>
<td>Histogram: CC</td>
<td>Threshold</td>
</tr>
<tr>
<td>Dataset NOTES</td>
<td>L1_Fit &amp; Dtr</td>
<td>TS Generate</td>
</tr>
<tr>
<td>Dataset Rename</td>
<td>LSqFit &amp; Dtr</td>
<td>Wavelets</td>
</tr>
</tbody>
</table>
1. Use blank copy (Dataset copy). Also set See OverLay.
2. Start Gyrus finder plug-in, and choose copy dataset
3. Set fill point in white matter (middle button)
4. Suggest range in white/gray finder window
5. Select Fill
6. Unfill and adjust search range, neighbor and connection constraints
7. Do gray matter Fill
8. Save data
ScatterPlot plug-in

Scatter Plot: 16570 Voxels (asmask+orig) $R^2 = 0.9833$
Environment Variables and .afnirc

- Operation of AFNI is affected by many Unix environment variables
  - Full documentation is in file README.environment (in AFNI distributions)
  - Environment variables can be set in your shell startup file (e.g., .cshrc) or in AFNI’s startup file (.afnirc), in your home directory
  - Some environment variables can be set from the pseudo-plugin
    - Define Datamode → Misc → Edit Environment

- Some useful environment variables (there are many more)
  - `AFNI_PLUGINPATH` gives the directory where AFNI will look for plugins when it starts up
  - `AFNI_SESSTRAIL` gives the number of directory levels to show in the Switch Session chooser
  - `AFNI_HINTS` can be used to turn off the popup hints (tooltips)
  - `AFNI_COMPRESSOR` can be used to tell AFNI programs to compress .BRIK files when they are written out
  - `AFNI_AUTOGZIP` can be used to tell AFNI programs to gzip compress .BRIK files if they appear like “good” candidates for compression (e.g., ROI datasets)
• **AFNI_LEFT_IS_LEFT** can be used to have axial and coronal images displayed with the subject’s left on the display left (default is subject’s left on the display right: radiological order)
• **AFNI_ALWAYS_LOCK** can be used to turn on inter-controller Lock at startup
• **AFNI_NOSPLASH** can be used to hide the AFNI splash window (but why?!)  
• **AFNI_ENFORCE_ASPECT** can be used to make defective window managers (KDE, Gnome) keep the image window aspect ratios when resizing (I then also recommend setting the window manager so that it doesn’t redraw the windows during resizing operations)

• Sample .afnirc file:

```
***ENVIRONMENT
AFNI_LEFT_IS_LEFT = YES // images show subject’s left on screen left
AFNI_graph_width = 512 // in pixels
AFNI_graph_height = 384
AFNI_graph_ggap = 6 // gap between sub-graphs
AFNI_graph_data_thick = 1 // use thick lines for data graphs
AFNI_SPLASHTIME = 1.0 // shorten the splash screen display
AFNI_ALWAYS_LOCK = YES // locking windows together
AFNI_ENFORCE_ASPECT = YES
AFNI_AUTOCZIP = YES // 02 Mar 2001
```

• See README.environment and README.setup for details on all environment variables and other setup issues
AFNI GUI Plugouts and command line options

#!/bin/tcsh
# '.afni.startup_script' in current directory.
# AFNI will automatically read such a file at
# startup and carry out its orders.
# ---------------------------------------
# Sample script to generate image file
# sss.jpg from the anat+tlrc and func+tlrc
datasets. See file README.driver for a list
# of all the functions you can invoke to drive
# AFNI from the outside. See file
# README.environment for other settings that
# can influence the way AFNI operates.

# Set environment variables to force square
# pixels in saved image, and linear
# interpolation in the functional overlay
# volumes

setenv AFNI_IMAGE_SAVESQUARE YES
setenv AFNI_resam_func Li
setenv AFNI_resam_thr Li

# Start AFNI with plugouts enabled
# Drive AFNI to set up the desired
# image, save it, then quit
afni -yesplugouts &
plugout_drive -verb -host localhost \
-com "SWITCH_UNDERLAY A.anat" \
-com "SWITCH_OVERLAY A.func" \
-com "SET_VIEW A.tlrc" \
-com "OPEN_WINDOW A.axialimage " \mont=5x5:5:2:green" \
-com "SET_DICOM_XYZ A.0 0 0" \
-com "SET_XHAIRS A.OFF" \
-com "SET_FUNC_RANGE A.777" \
-com "SET_THRESHNEW A.0.666 *" \
-com "SET_PBAR_NUMBER A.9" \
-com "SET_FUNC_VISIBLE A.+" \
-com "SAVE_JPEG A.axialimage sss.jpg" \
-com "QUIT"

Or ...

afni -com 'OPEN_WINDOW A.axialimage' \
-com 'SWITCH_UNDERLAY A.fred' \
-com 'SET_VIEW A.tlrc' \
somedirectory
Matlab Library

Opening and Saving AFNI datasets

BrikInfo
BrikLoad
WriteBrik

Functions that deal with voxel coordinates

AFNI_XYZcontinuous2Index
AFNI_Index2XYZcontinuous
AFNI_CoordChange

Functions that deal with extracting and selecting slices a la AFNI

GetAfniSlice
GetAfniSliceTriplet
Examination to become an AFNI Certified Expert (first step on the road to glory)

1. Explain the difference between 'Min-to-Max' and '2%-to-98%' in the AFNI image viewer. Why is 2%-to-98% the default?
2. What does the 'R' key do when typed into an AFNI image viewer window? What about in a graph viewer window?
3. On some systems, it is possible to drag an image viewer window so that its aspect ratio (height/width) is not preserved; in this situation, the image becomes distorted. Describe at least 2 ways to bring the image viewer quickly back into the correct aspect ratio.
4. What does the 'Project' menu button do in the AFNI image viewer Disp control panel?
5. When you have 2 (or more) AFNI controllers open, can you lock their threshold sliders so that they move together? If so, how?
6. In an AFNI graph viewer window, how can you get a display of the time series that is the average of all the sub-graphs currently being shown?
7. Suppose you are showing a time series graph of a very long 3D+time dataset, and want to only see the points between time indexes 200..400 displayed in the graphs. How can you do this?
8. Explain the 3 different baseline modes available in an AFNI graph viewer.
9. On most systems, the AFNI interface shows the cursor as an arrow pointing to the upper left, but this arrow changes shape and color slightly when you move it over certain controls. What does this cursor shape change mean?
10. Given a list of coordinates, describe one way to create an AFNI dataset that equals 1 at each point inside a sphere of radius 5 about each coordinate in the list, and equals zero at all other points.
11. Explain why it is better to use the 3dcopy program to make a copy of an AFNI dataset (.HEAD and .BRIK files) rather than use the Unix 'cp' command twice.
12. How do you get AFNI '3d' programs to treat a .1D file with a single column of numbers as a 1-voxel 3D+time dataset?
13. How do you get AFNI to automatically compress output .BRIK files with gzip?