

# **MINC meeting 2003**

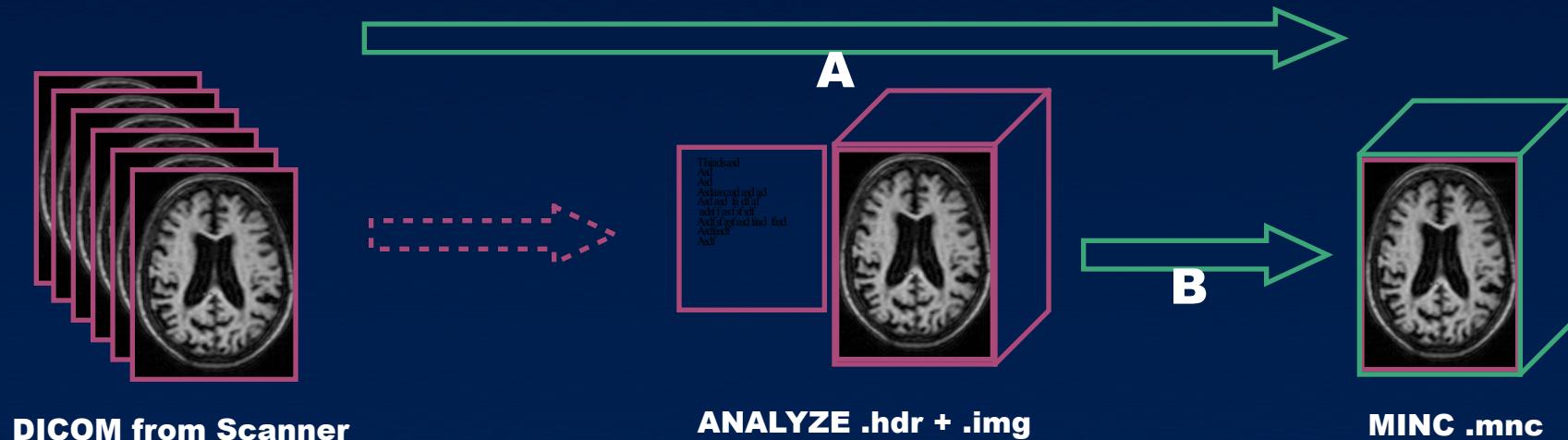
## **Getting your data into MINC and more**

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# All very nice, but what about my data?

- **2 typical pathways**
  - A: Convert original data (DICOM, GE, Siemens)
  - B: Convert from other format (Analyze, VoxBo, UNC, etc)



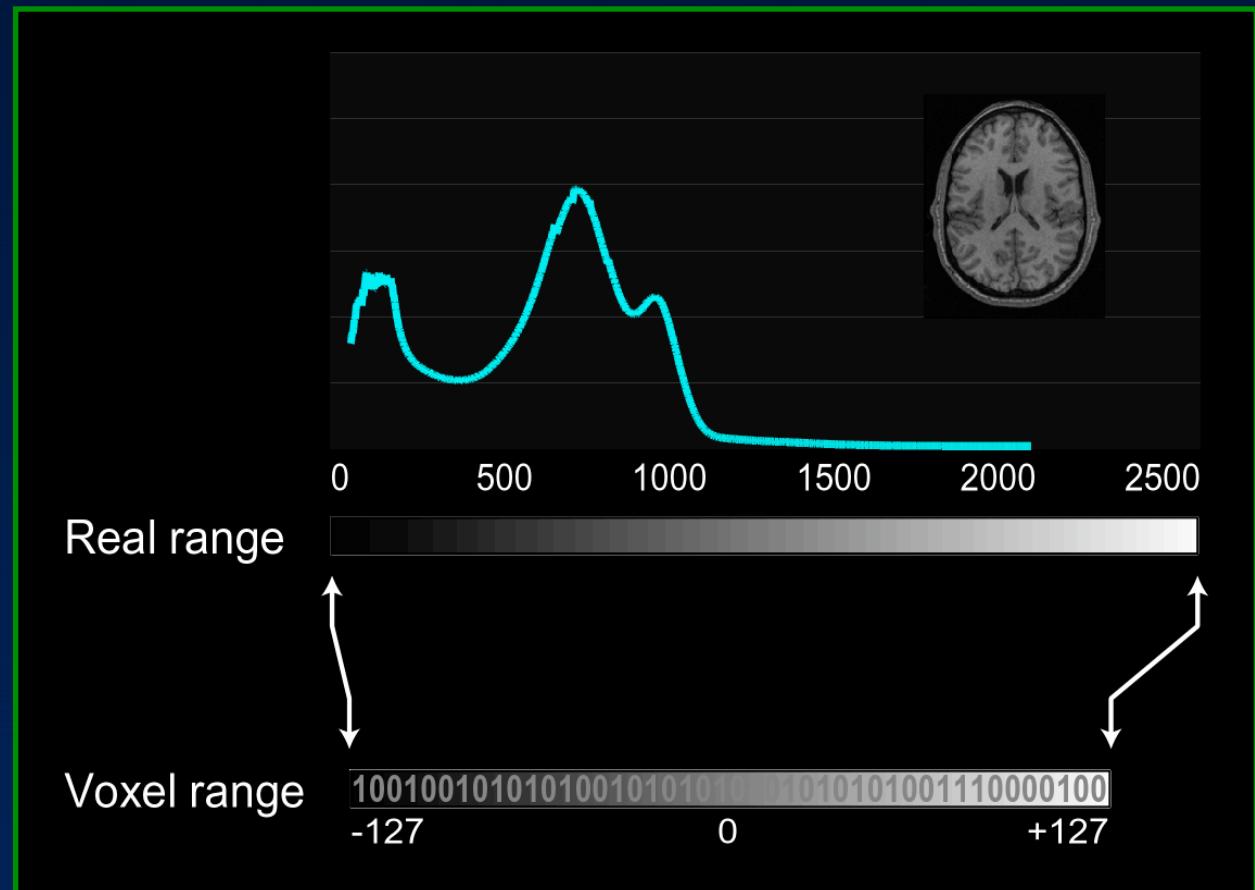
- **A is preferable**
  - Inconsistencies and shortfalls of some other formats.

# **rawtominc – the crux of conversion**

- **Essential information**
  - Dimension sizes
  - Data type (byte, short, float, signed/unsigned)  
`rawtominc out.mnc 256 256 12 <  
analyze.img`
- **“good” information**
  - Dimension step, start (-xstart, -ystep, etc)
  - Direction cosines

# Image range conversion in MINC

- **Image range vs Real range**
  - “scaling” factor
- **Real range can be arbitrary**
  - 1..0
  - 0.0001..0.0003
  - etc

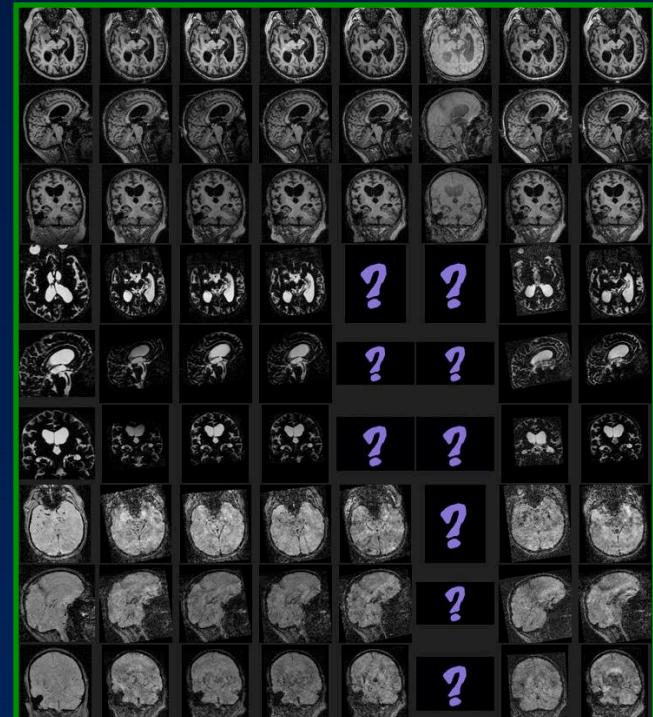
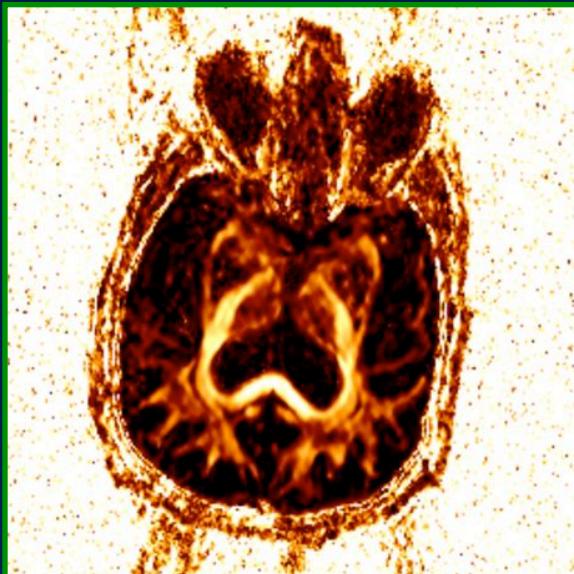


# “automatic” conversion

- **Typically perl scripts**
  - Read the required values from pertinent image headers
- **Can be difficult to write a general converter**
  - Analyze AVW vs SPM vs AFNI
  - Incomplete or unavailable documentation
  - Too simplistic headers
- **<http://www.cmr.uq.edu.au/~rotor/minc>**

# New MINC tools - mincpik

- **Create images from MINC files**
  - Uses the `convert` tool from ImageMagick
  - Generate processing checking montages



```
mincpik -transverse -slice 10 -image_range 0.1 0.9 \
-lookup -hotmetal FA.mnc FA_transverse.jpg
```

# New MINC tools - minchistory

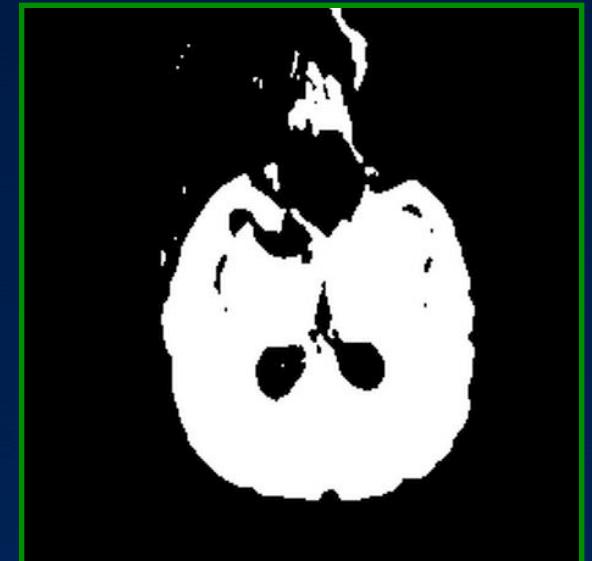
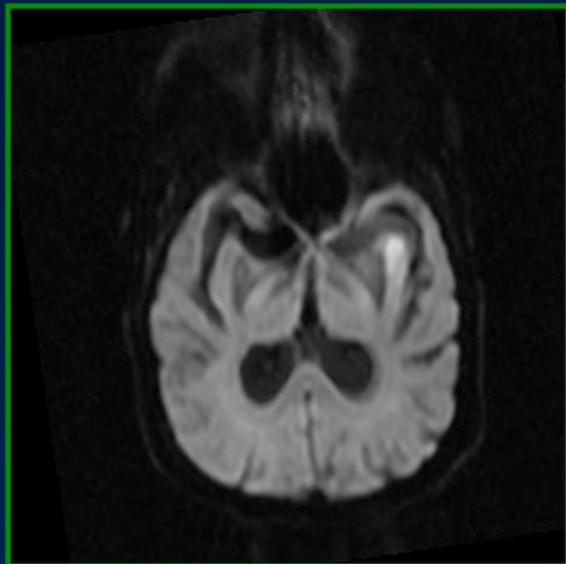
- Print value of :history variable

```
$ minchistory FA.reg.mnc
--- History of B027915.01_DTI.B0.reg.clp.mnc ---
[01] Thu Nov 21 14:28:14 2002>>> mincaverage -clobber \
    /usr/people/steve/data/stroke/B027915/01_DTI/B027915.01_DTI.frame001.mnc \
    /usr/people/steve/data/stroke/B027915/01_DTI/B027915.01_DTI.frame002.mnc \
    /usr/people/steve/data/stroke/B027915/01_DTI/B027915.01_DTI.frame003.mnc \
    /usr/people/steve/data/stroke/B027915/01_DTI/B027915.01_DTI.frame008.mnc \
    /usr/people/steve/data/stroke/B027915/01_DTI/B027915.01_DTI.B0.mnc
[02] Mon Nov 3 16:54:24 2003>>> mincresample -clobber -like \
    /home/rotor/data/stroke/B027915/01_DTI/B027915.01_DTI.B0.mnc \
    -transformation \
    /home/rotor/data/stroke/B027915/xfms/B027915.01_DTI.midline-align.xfm \
    /home/rotor/data/stroke/B027915/01_DTI/B027915.01_DTI.B0.mnc \
    /home/rotor/data/stroke/B027915/reg/B027915.01_DTI.B0.reg.mnc
[03] Mon Nov 10 23:50:21 2003>>> minccalc -clobber -outfile value \
    /home/rotor/data/stroke/B027915/00_MDL/B027915.01_DTI.B0.reg.clp.mnc \
    -outfile mask \
    /home/rotor/data/stroke/B027915/00_MDL/B027915.01_DTI.B0.reg.vmsk.mnc \
    -expression value = A[0]; mask = 1; if(value < 2.037950563e-05){ value = \
    2.037950563e-05; mask = 0; } else{ if(value > 1971.714904){ value = \
    1971.714904; mask = 0; }; }; value = \
    (value-2.037950563e-05)/1971.71488362049; \
    /home/rotor/data/stroke/B027915/reg/B027915.01_DTI.B0.reg.mnc
```

# **mincmorph – morphological operators**

- **Masking an image from background**
  - First find background threshold

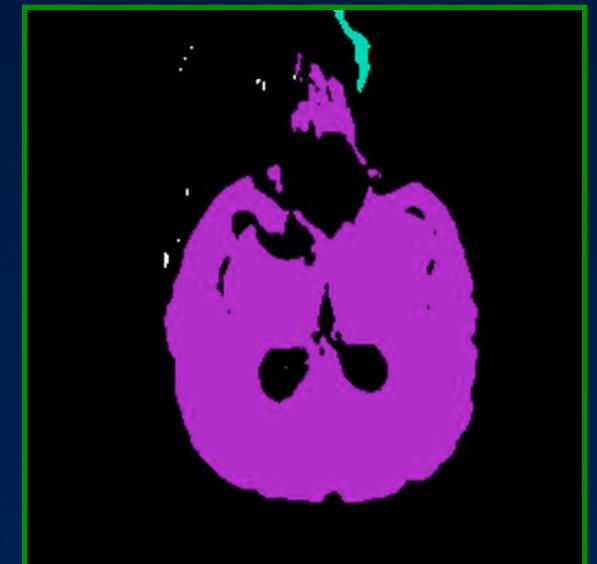
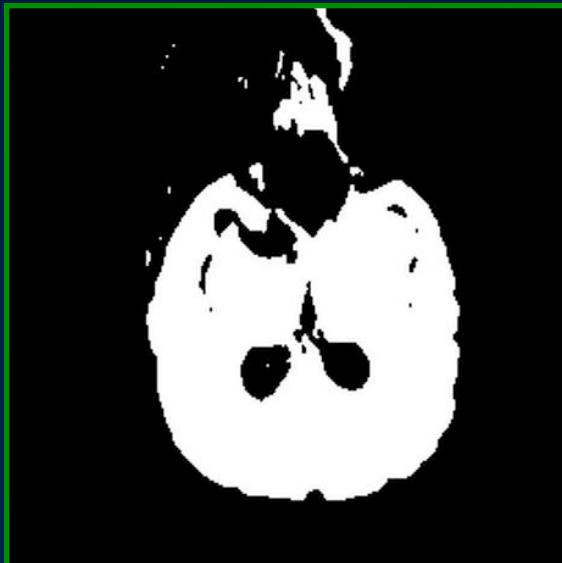
```
$ mincstats -biModal file.mnc  
BiModalT: 0.1347499937
```



```
$ mincmorph -byte -successive 'B[0.134]' file.mnc out.mnc
```

# **mincmorph – morphological operators**

- **Connected component labeling**
  - Labeled by group size



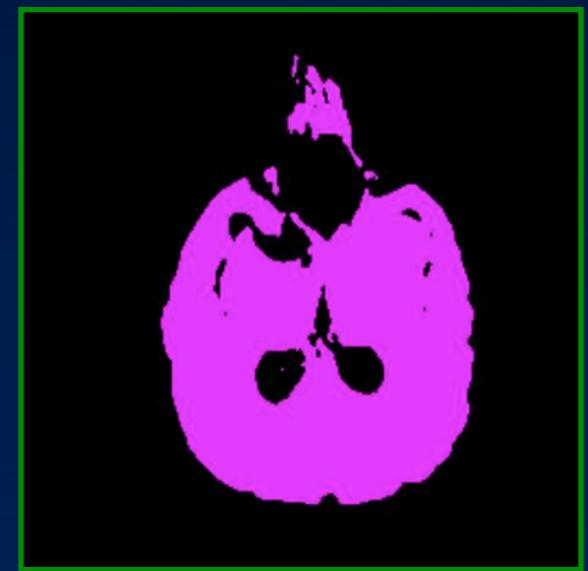
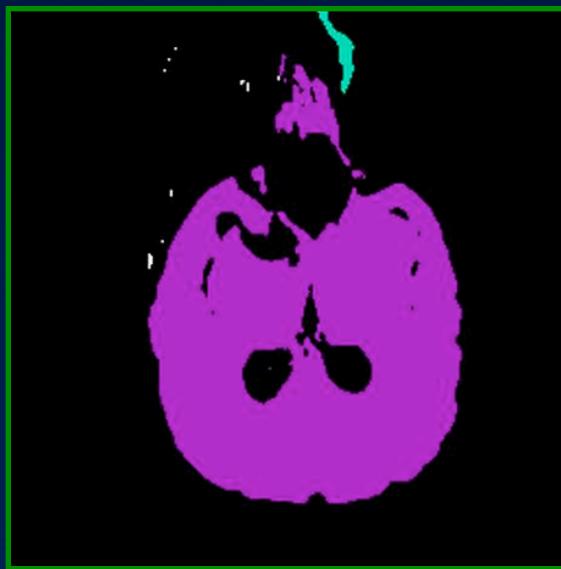
```
$ mincmorph -byte -successive 'B[0.134]G' file.mnc out.mnc
```

# mincstats – group sizes

```
$ mincstats -discrete_histogram -histogram out.hist out.mnc
...
$ cat out.hist
# histogram for: foo.mnc
# mask file:      (null)
# domain:        -0.5  255.5
# entropy:       0.760066
# bin centres          counts
0                  997826
1                 242670
2                   1343
3                     621
4                     527
5                     408
6                     386
7                     315
8                     225
9                     107
10                    92
11                     78
12                     65
13                     40
14                     36
...
```

# mincmorph – morphological operators

- **Keep largest group (in 3D)**
  - Set remaining to background value (0)



```
$ mincmorph -byte -successive 'B[0.134]GK[0:1]' file.mnc out.mnc
```

# mincmorph – morphological operators

- **Kernel files**

- The life and soul of mincmorph
- Used for dilations, erosions, convolution, group connectivity
- Default is a 3D 8-connectivity kernel

- **Can use for edge detection**

```
MNI Morphology Kernel File
%
% 2D 8-connectivity ie:
%
%      1 1 1
%      1 0 1
%      1 1 1
%
% 0 - center voxel

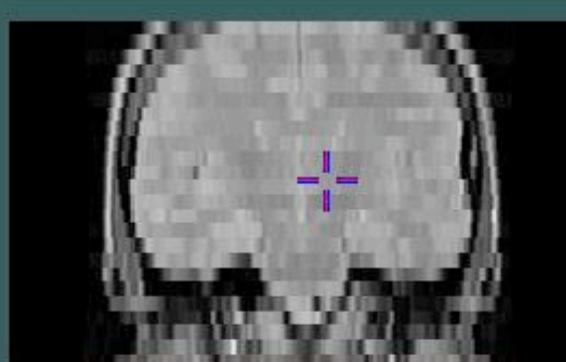
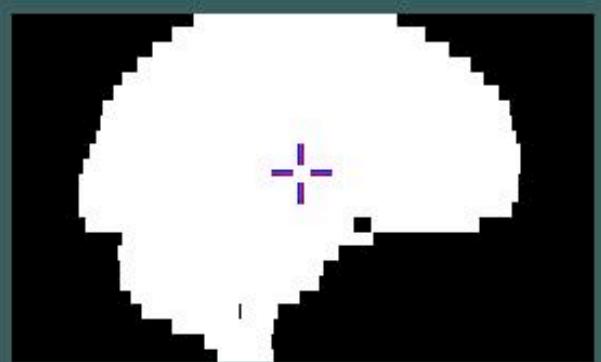
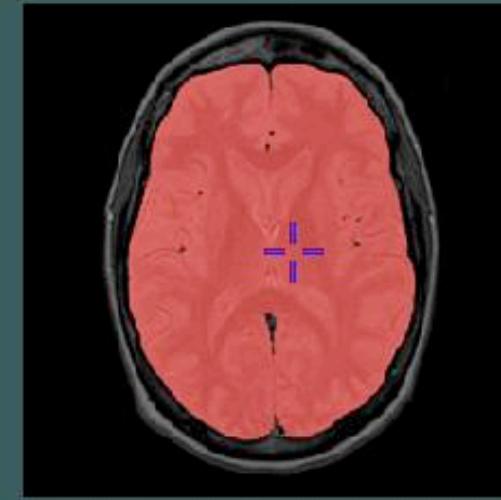
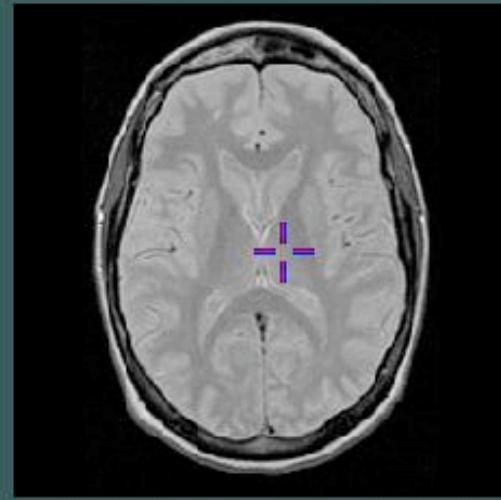
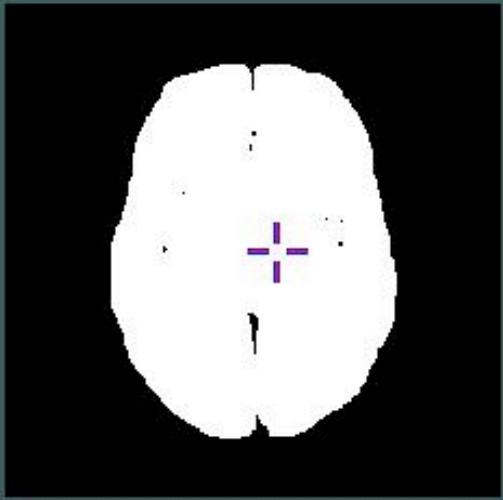
Kernel_Type = Normal_Kernel;
Kernel =
% -----
%      x      y      z      t      v      coeff
% -----
        1.0    1.0    0.0    0.0    0.0    1.0
        1.0    0.0    0.0    0.0    0.0    1.0
        1.0   -1.0    0.0    0.0    0.0    1.0
%
        0.0    1.0    0.0    0.0    0.0    1.0
%%       0.0    0.0    0.0    0.0    0.0    1.0
        0.0   -1.0    0.0    0.0    0.0    1.0
%
       -1.0    1.0    0.0    0.0    0.0    1.0
       -1.0    0.0    0.0    0.0    0.0    1.0
      -1.0   -1.0    0.0    0.0    0.0    1.0;
```

# mincmorph – morphological operators

- **Keep largest group (in 3D)**
  - Set remaining to background value (0)



```
mincmorph -byte -successive 'B[0.134]GK[0:1]R[./3x3_8-conn.kern]DDEE' file.mnc out.mnc
```



# mincmorph – morphological operators

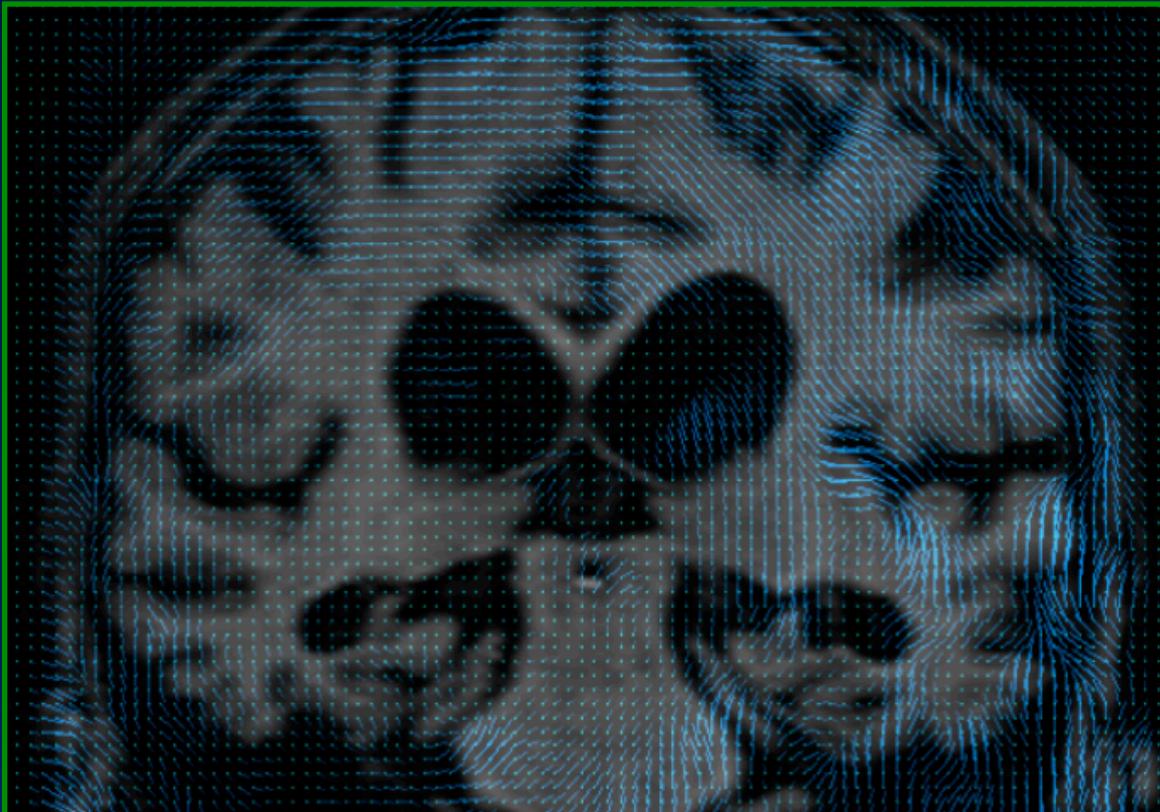
- **Prewitt operator**
  - multiples are applied at various angles

```
MNI Morphology Kernel File
%
% 045 deg prewitt kernel:
%
% +1 +1 +1
% -1 -2 +1
% -1 -1 +1

Kernel_Type = Normal_Kernel;
Kernel =
% -----.
%      x      y      z      t      v      coeff
% -----
-1.0  1.0  0.0  0.0  0.0  +1.0
  0.0  1.0  0.0  0.0  0.0  +1.0
  1.0  1.0  0.0  0.0  0.0  +1.0
%
-1.0  0.0  0.0  0.0  0.0  -1.0
  0.0  0.0  0.0  0.0  0.0  -2.0
  1.0  0.0  0.0  0.0  0.0  +1.0
%
-1.0 -1.0  0.0  0.0  0.0  -1.0
  0.0 -1.0  0.0  0.0  0.0  -1.0
  1.0 -1.0  0.0  0.0  0.0  +1.0;
```

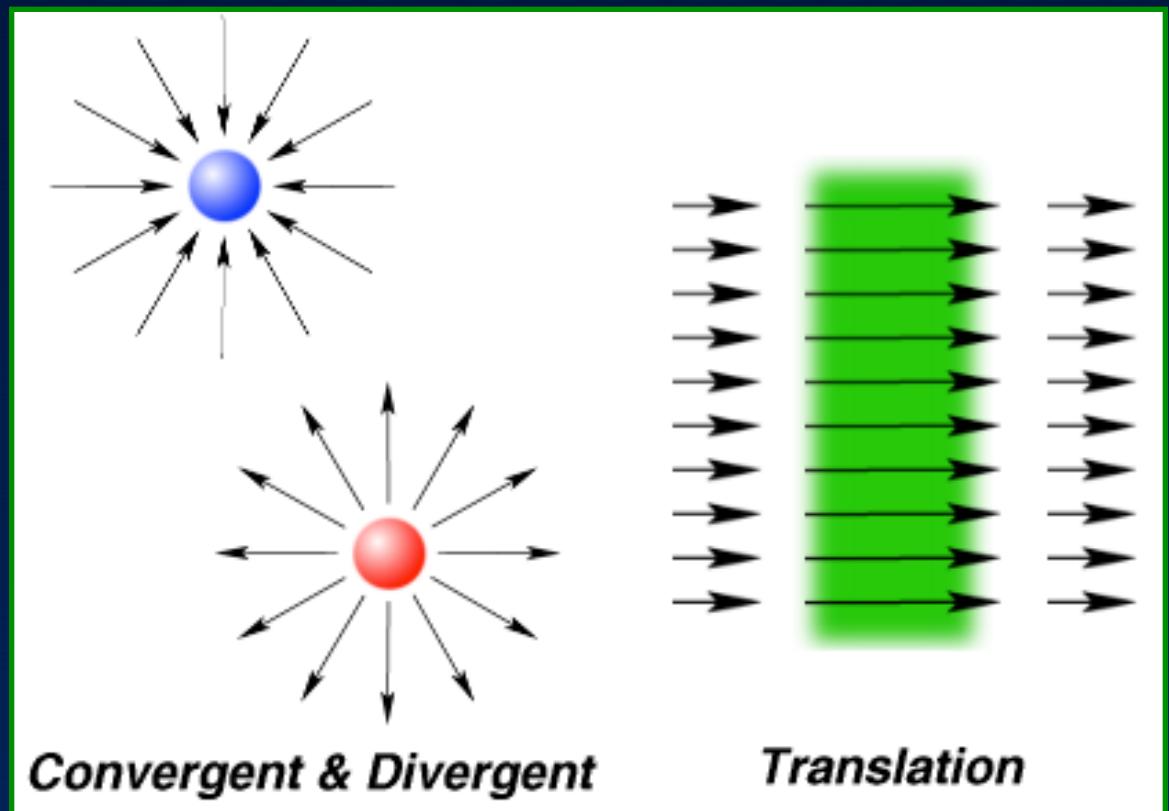
# mincblob – non-linear grid analysis

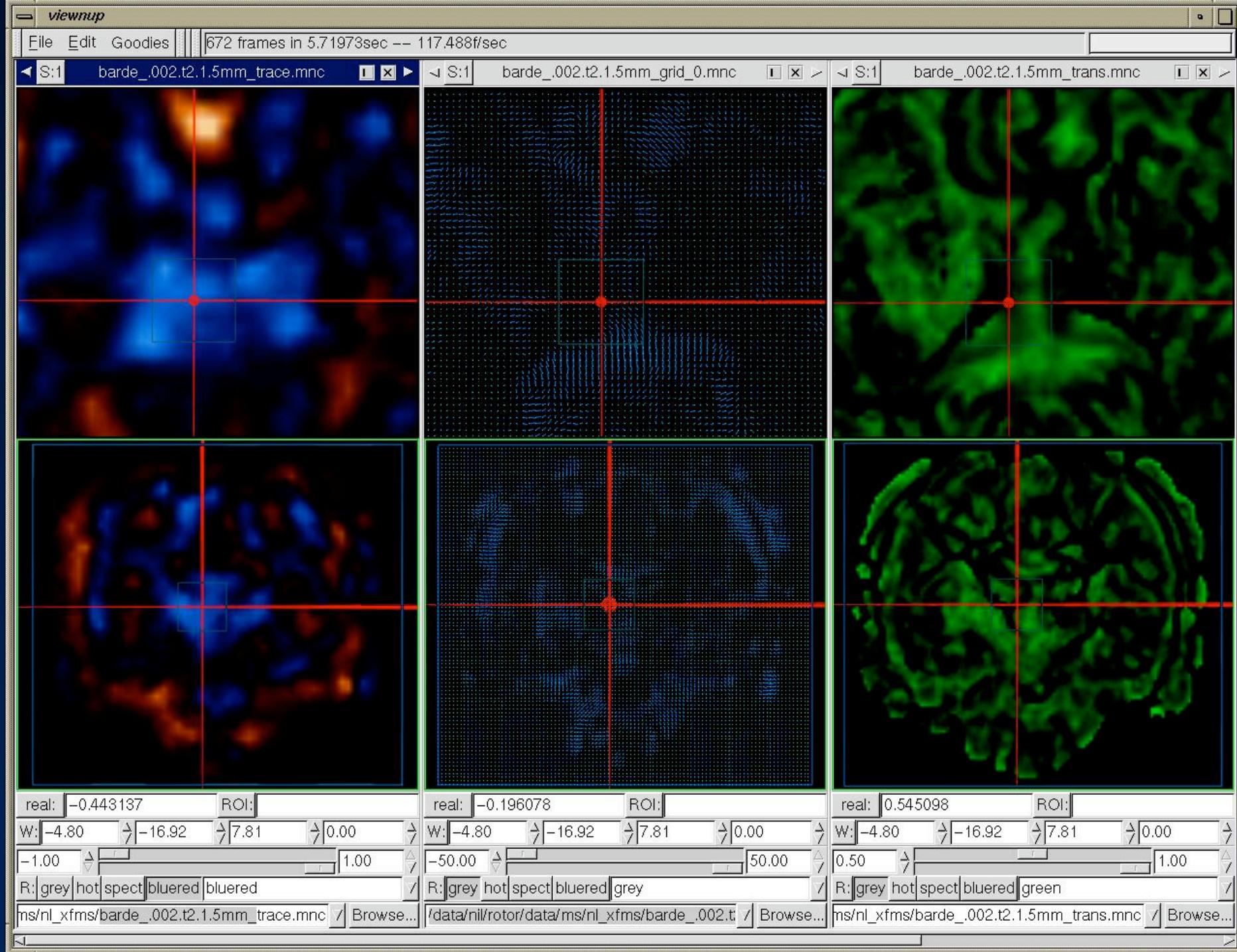
- **Deformations generated by Animal**



# minblob – non-linear grid analysis

- **Deformation analysis**
  - trace
  - determinant
  - local translation  
( $\arccos + \text{norm}$ )



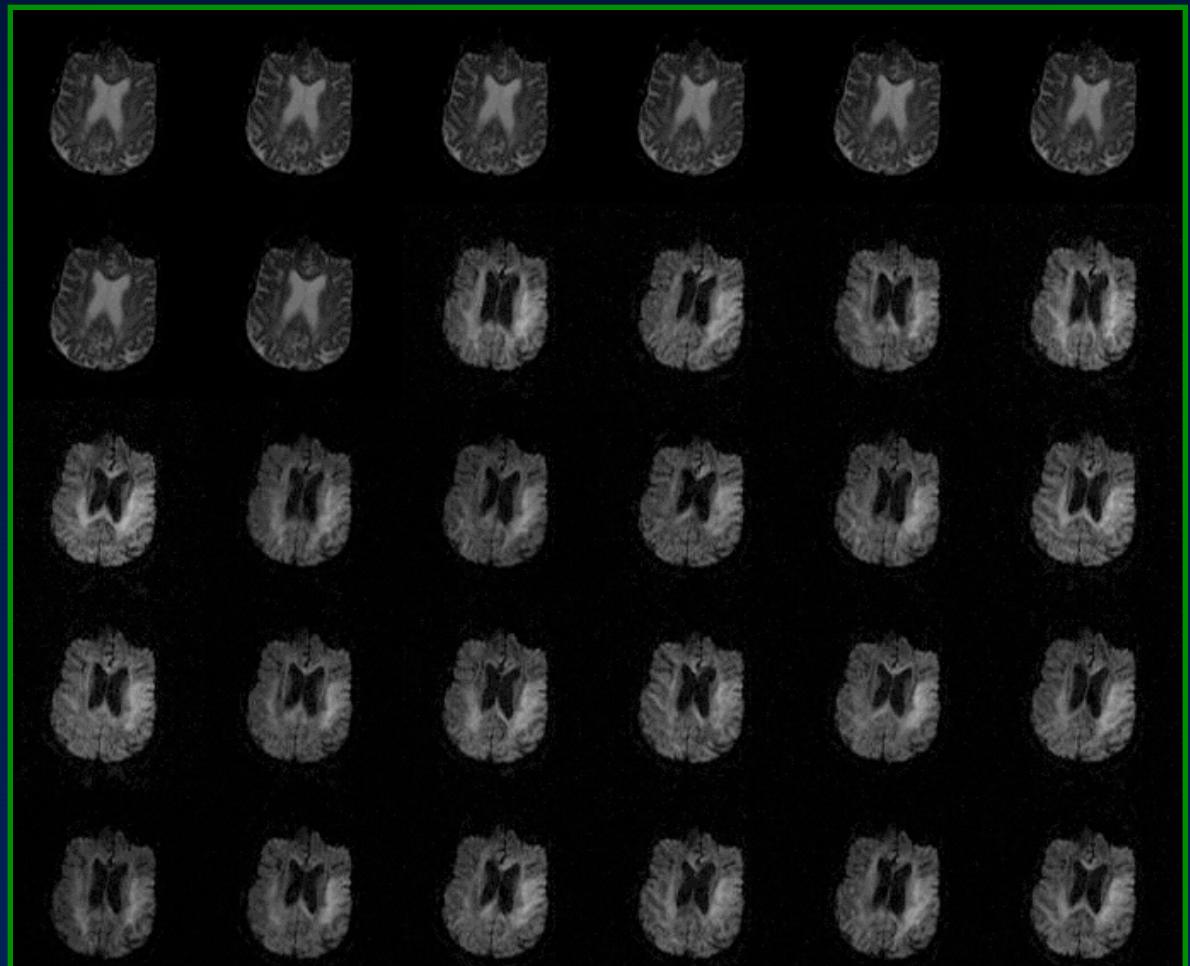


# New things on the way

- **All these tools are available but not on the CD**
  - need to gauge interest to specific tools for specific tasks
- **Various C/L tools:**
  - mincdti
  - vol\_ts\_reg - find\_art - volperf
  - mincfft
  - mincsample
- **Many link to external libraries**
  - GSL, FFTW, Glib etc

`mincdti + mincalc` = **Diffusion maps**

- **Raw diffusion time series**
  - 30 bvalue images

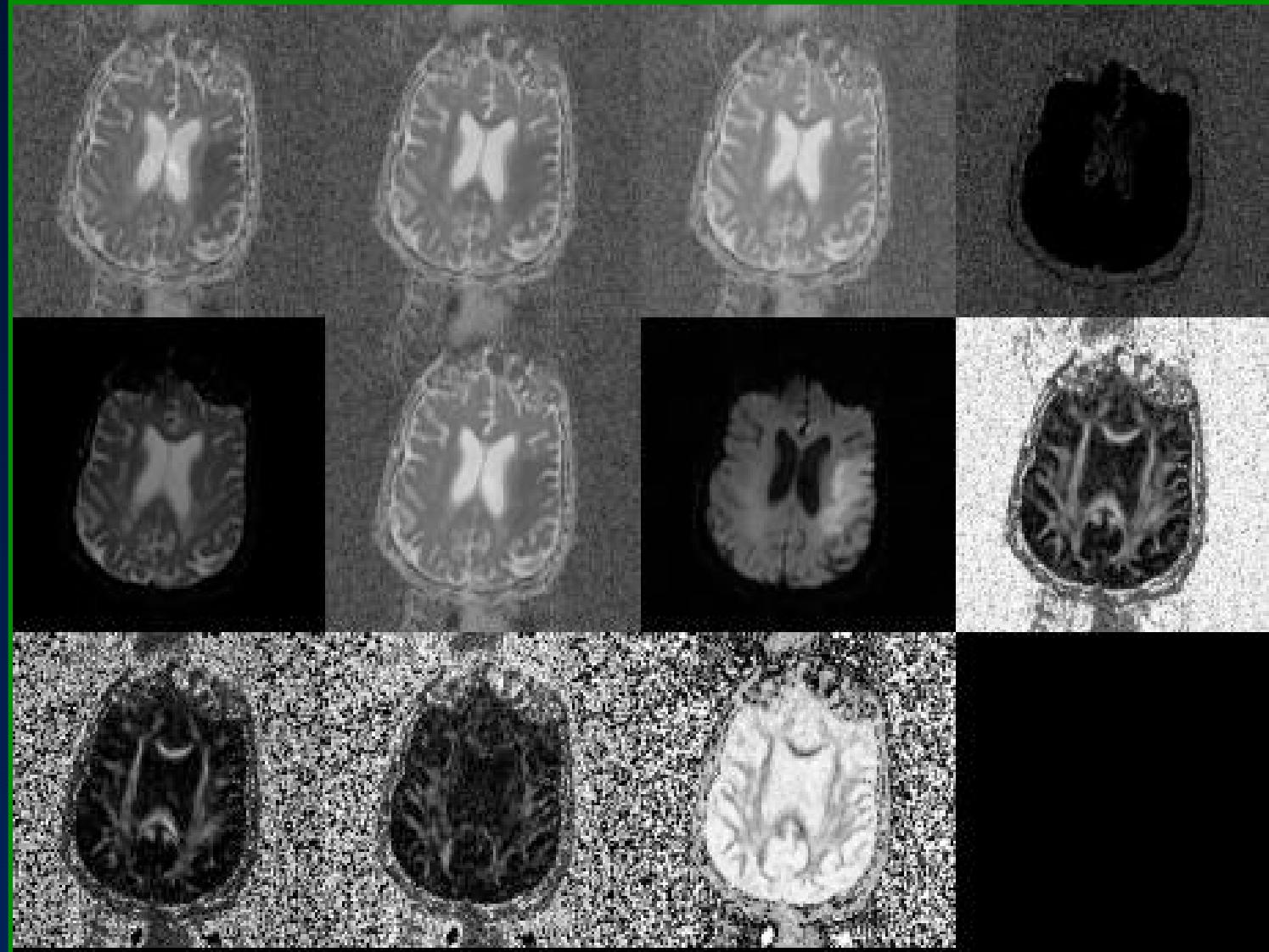


# SVD, diagonalisation and maps of tensor

eigen value  
1,2,3 +  
chisq fit

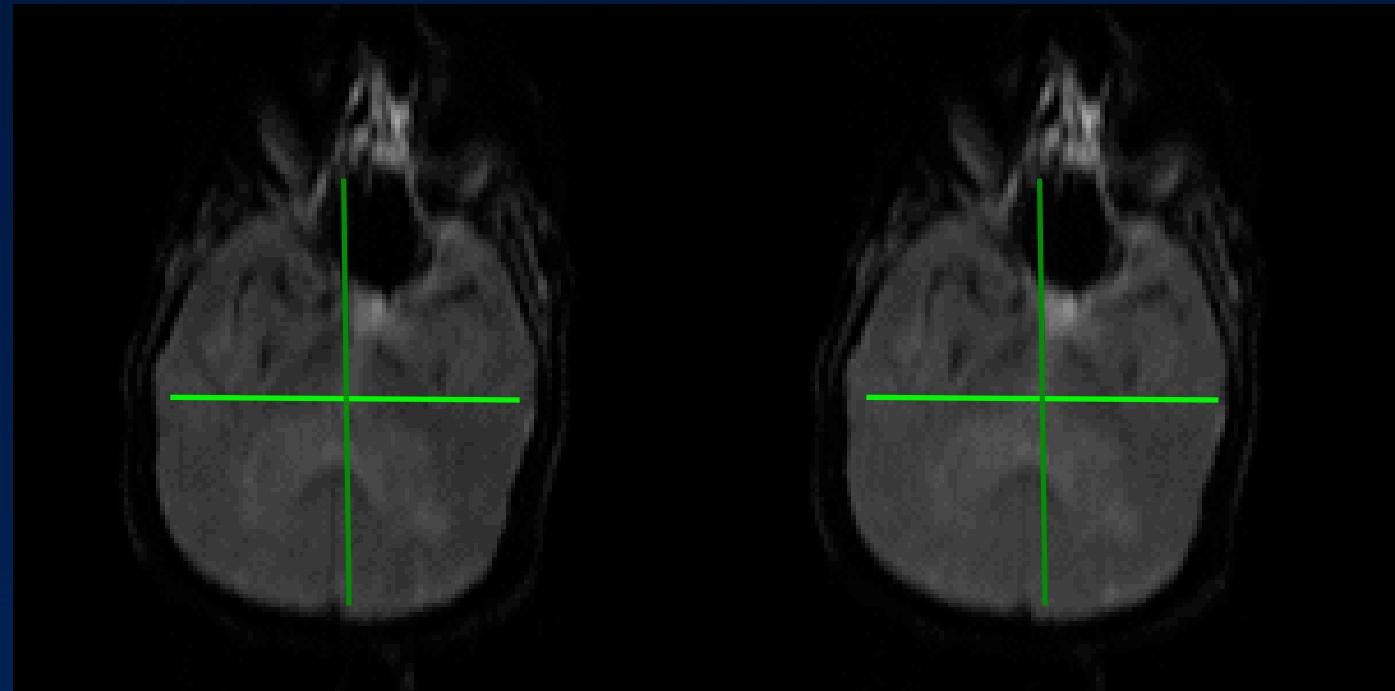
B0, ADC,  
ISO + FA

CL, CP +  
CS



## vol\_ts\_reg

- **Uses minctracc to do simple time-series registration**

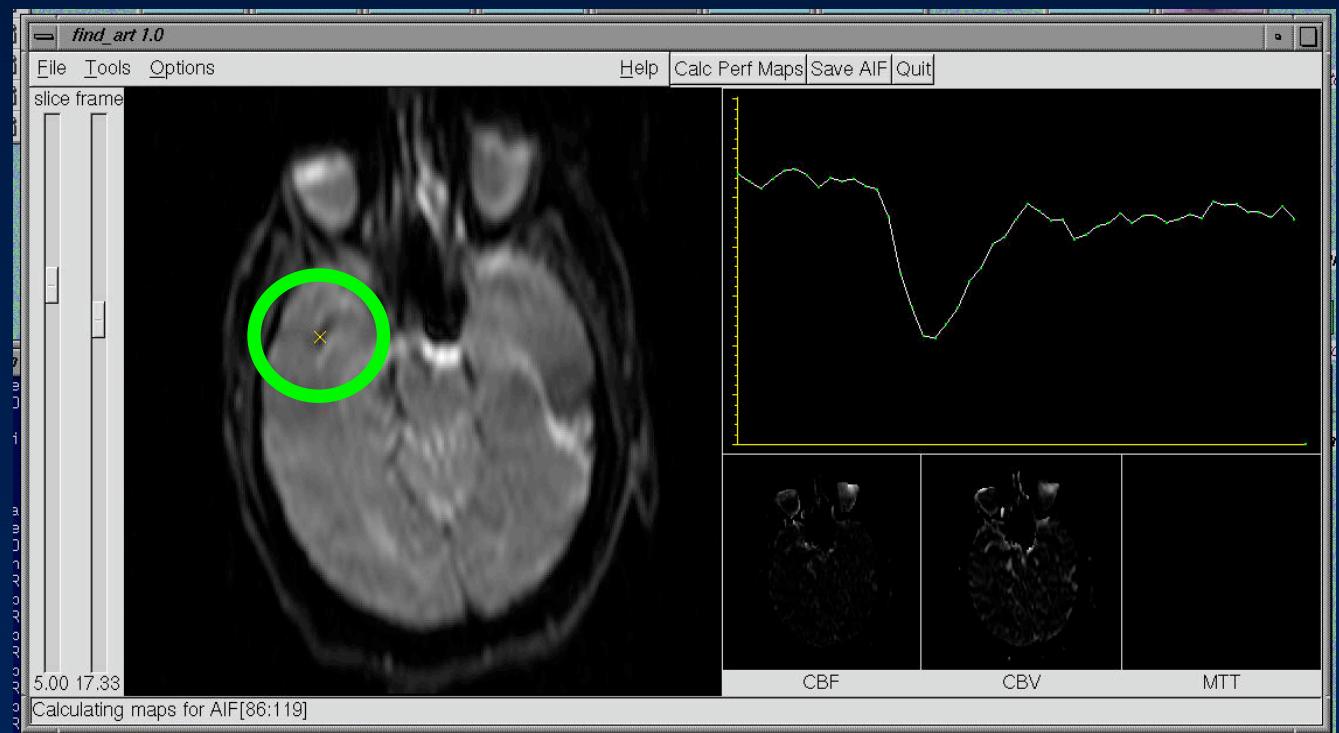


```
vol_ts_reg *.frame*.mnc -reg_ext ts_reg
```

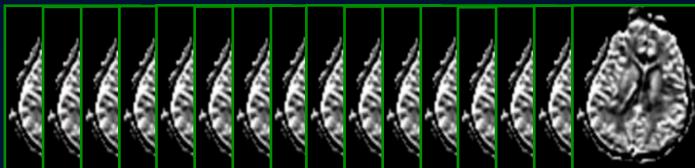
# volperf

- **Calculate corrected and uncorrected perfusion indices**

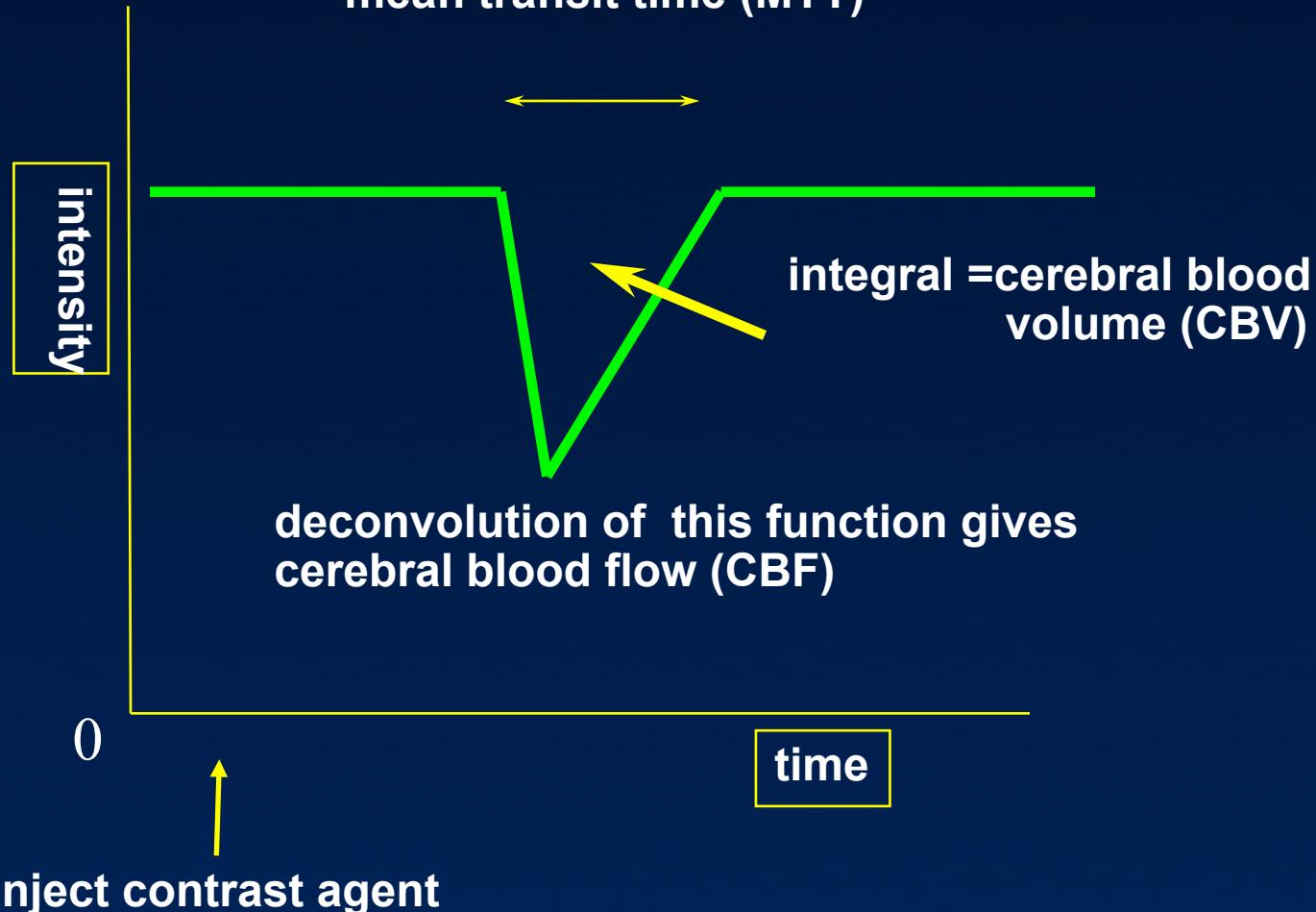
- find aif with  
find\_art



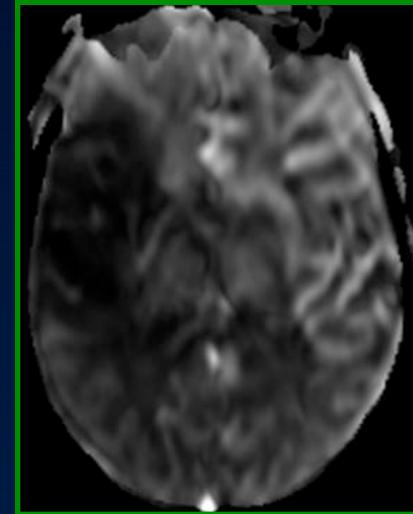
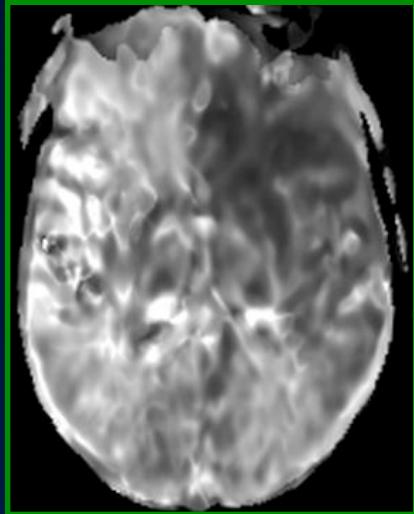
# Perfusion Maps



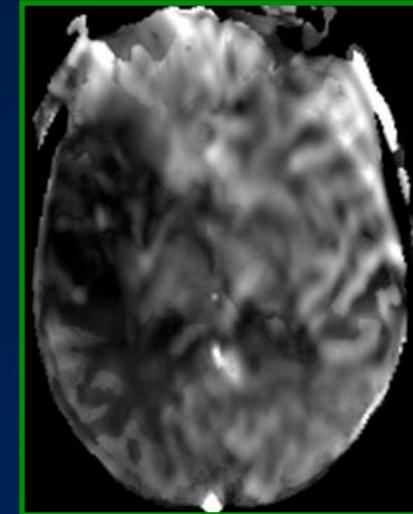
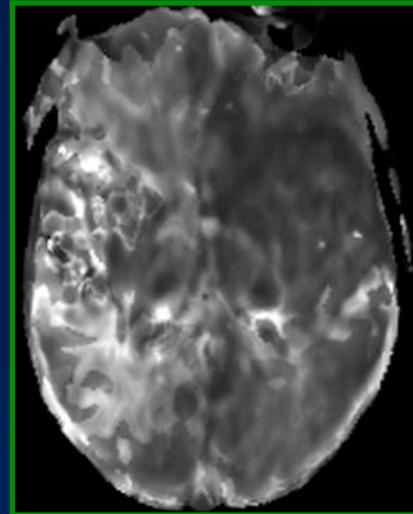
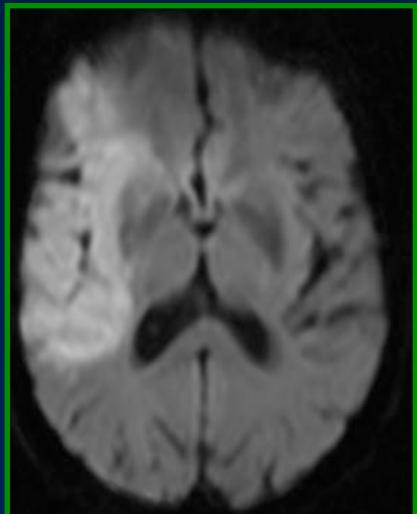
mean transit time (MTT)



`volperf -aif contralateral.aif *.frame.ts_reg.mnc outbase`

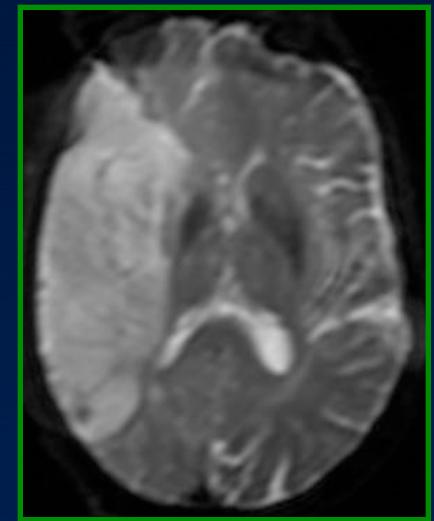


uncorrected MTT and CBF



DWI

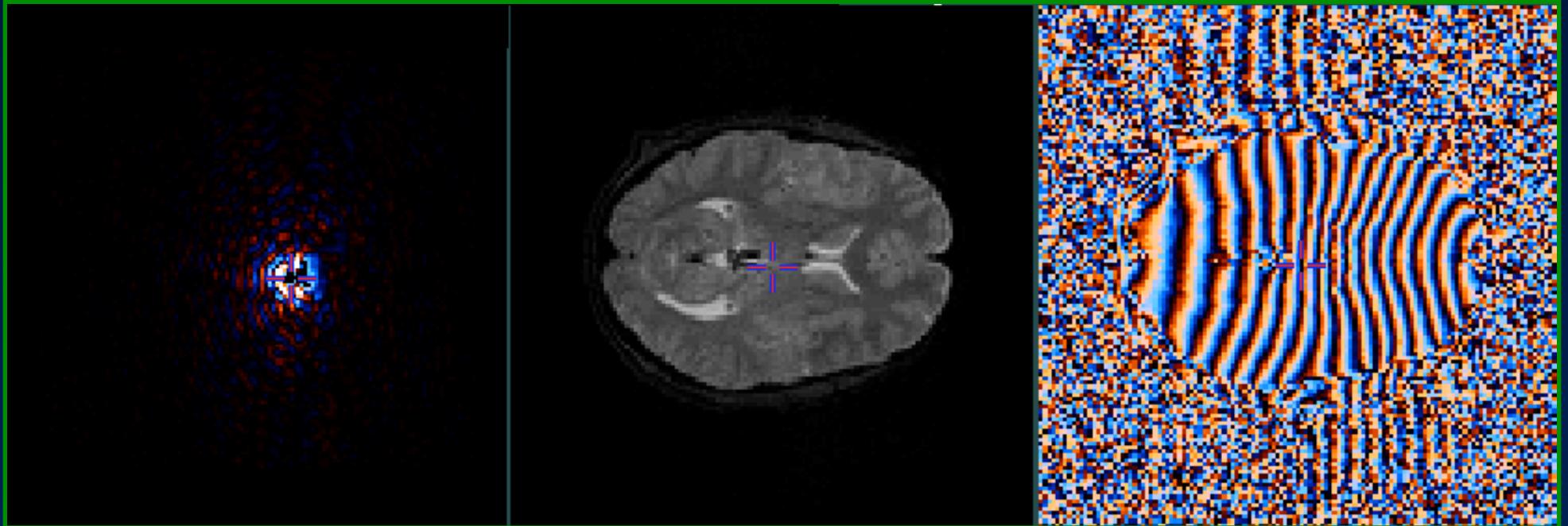
bolus delay corrected MTT and CBF



30 day T2

# **mincfft - FFT and FFT<sup>-1</sup> via FFTW**

- **Magnitude and Phase reco from FID**



```
mincfft -2D k-space.mnc -magnitude mag.mnc -phase phase.mnc
```

# Acknowledgements

- **Mark Griffin (code)**
- **What are your interests?**