

Calibration Study of DTI

Our strategy

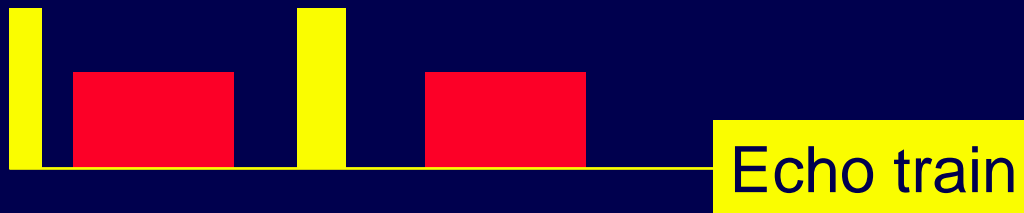
- Identify parameters that significantly influence results of DTI (intra-institution)
 - Anisotropy values
 - Fiber orientation
 - Tracking
- Setup common protocol and perform
- Perform inter-institution variability study

Sources of variability

Diffusion weighting

Acquisition

Subjects



- Gradient orientation
- b-value
- Echo time

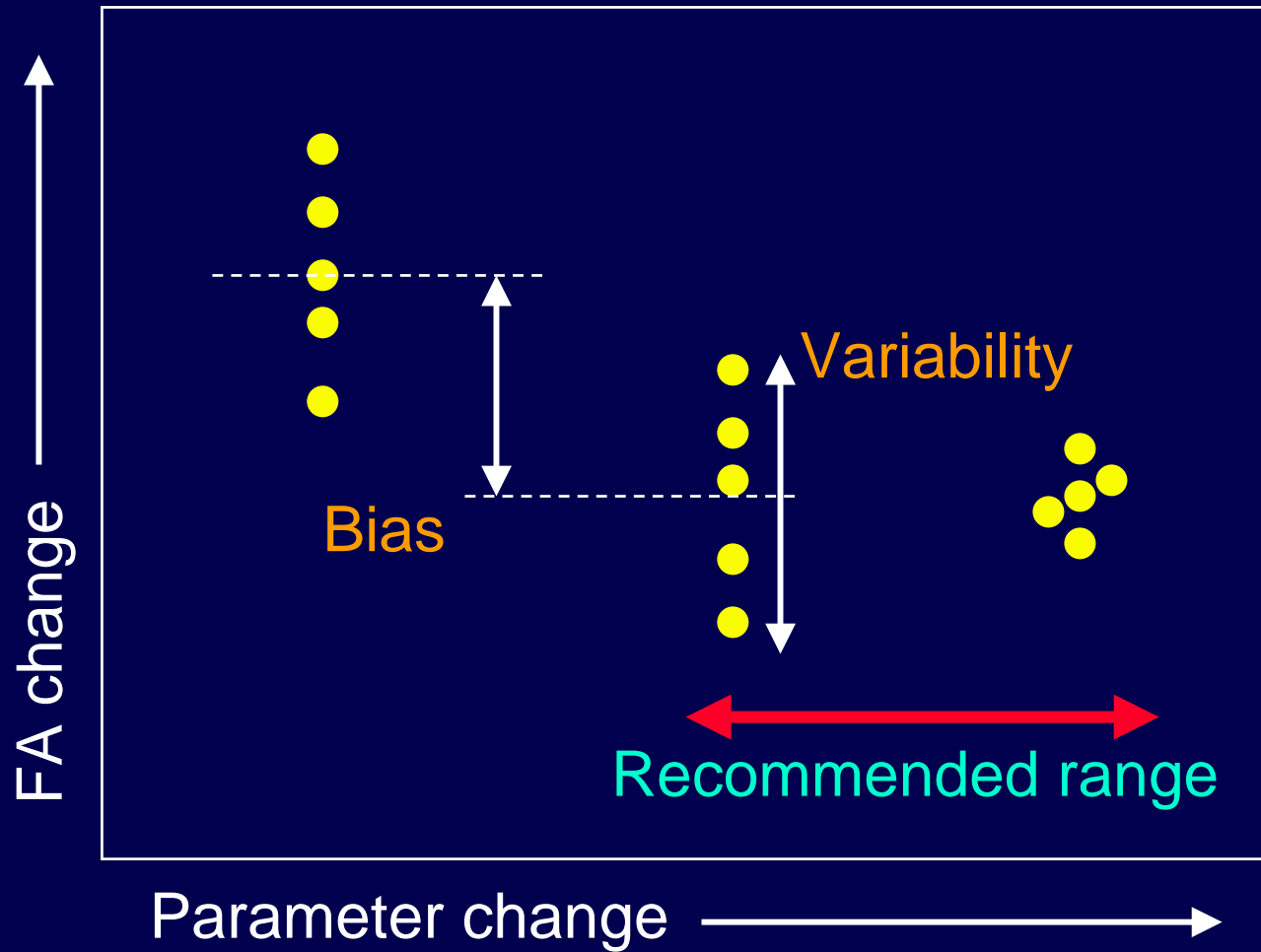
- Resolution
- SNR
- B0-distortion*
- SENSE

- Physiological motion
- Bulk motion*

*: DTI non-specific issue

Underline: Simulation has been published

Variability vs Bias



Experiment!/: SNR – FA relationship

B:	1000 s/mm ²
Orientation:	Jones30
TE:	100 ms
Repetition:	6 times
SENSE:	2
Time:	4.5 min (+2.5 min)

X 3 separate sessions

SNR study

5 b0

5 b0

5 b0

5 b0

5 b0

5 b0

30 ori.

30 ori.

30 ori.

30 ori.

30 ori.

30 ori.



tensor

tensor

tensor

tensor

tensor

tensor

tensor

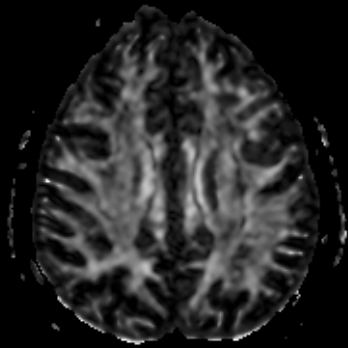
tensor

tensor

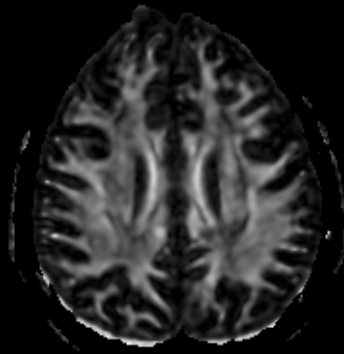
tensor

tensor

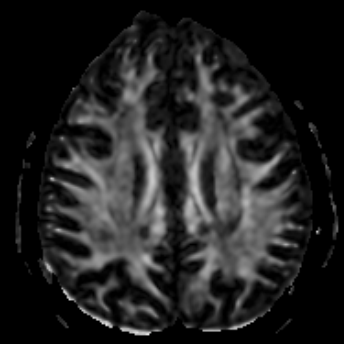
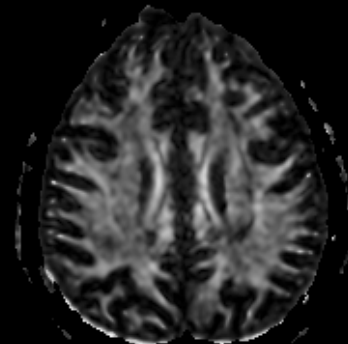
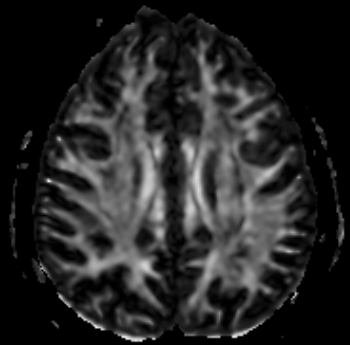
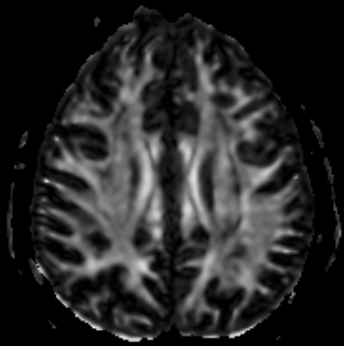
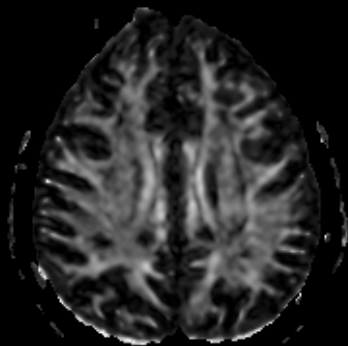
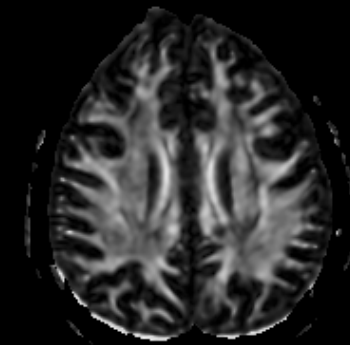
1 NEX



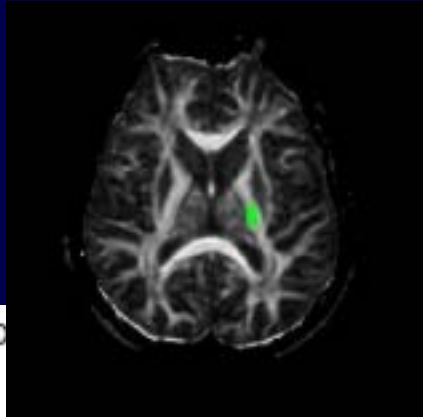
2 NEX



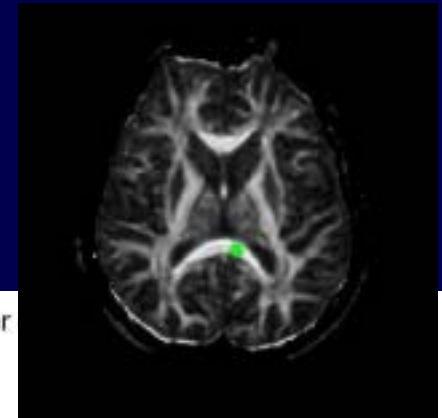
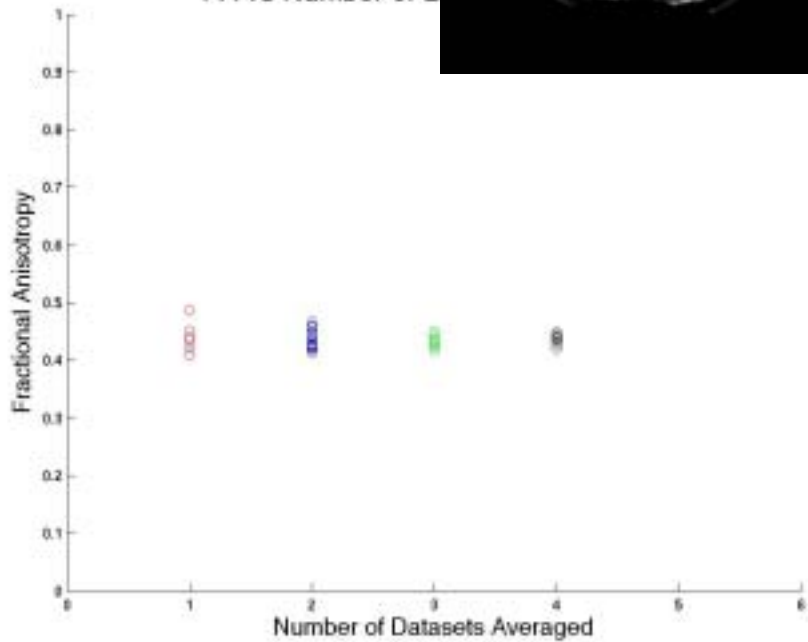
3 NEX



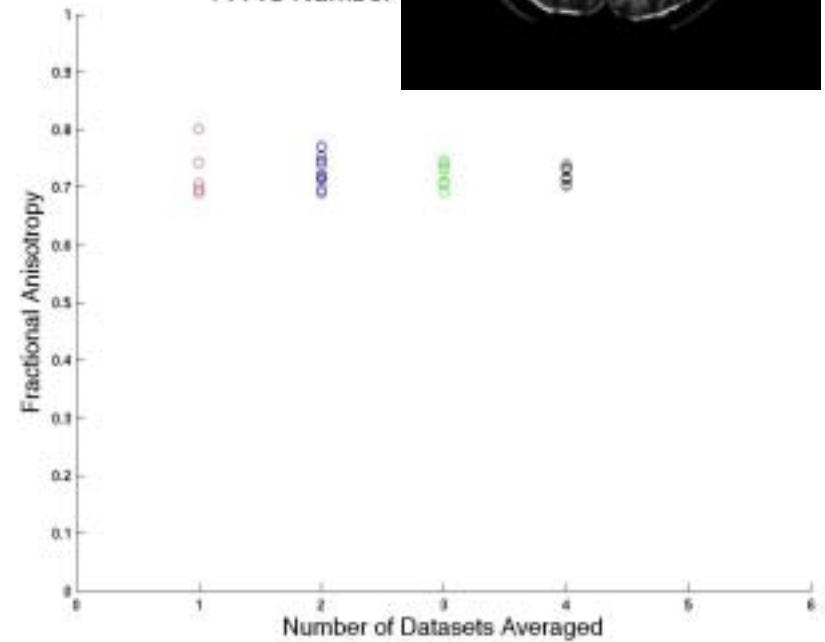
Repetition - FA



FA vs Number of D

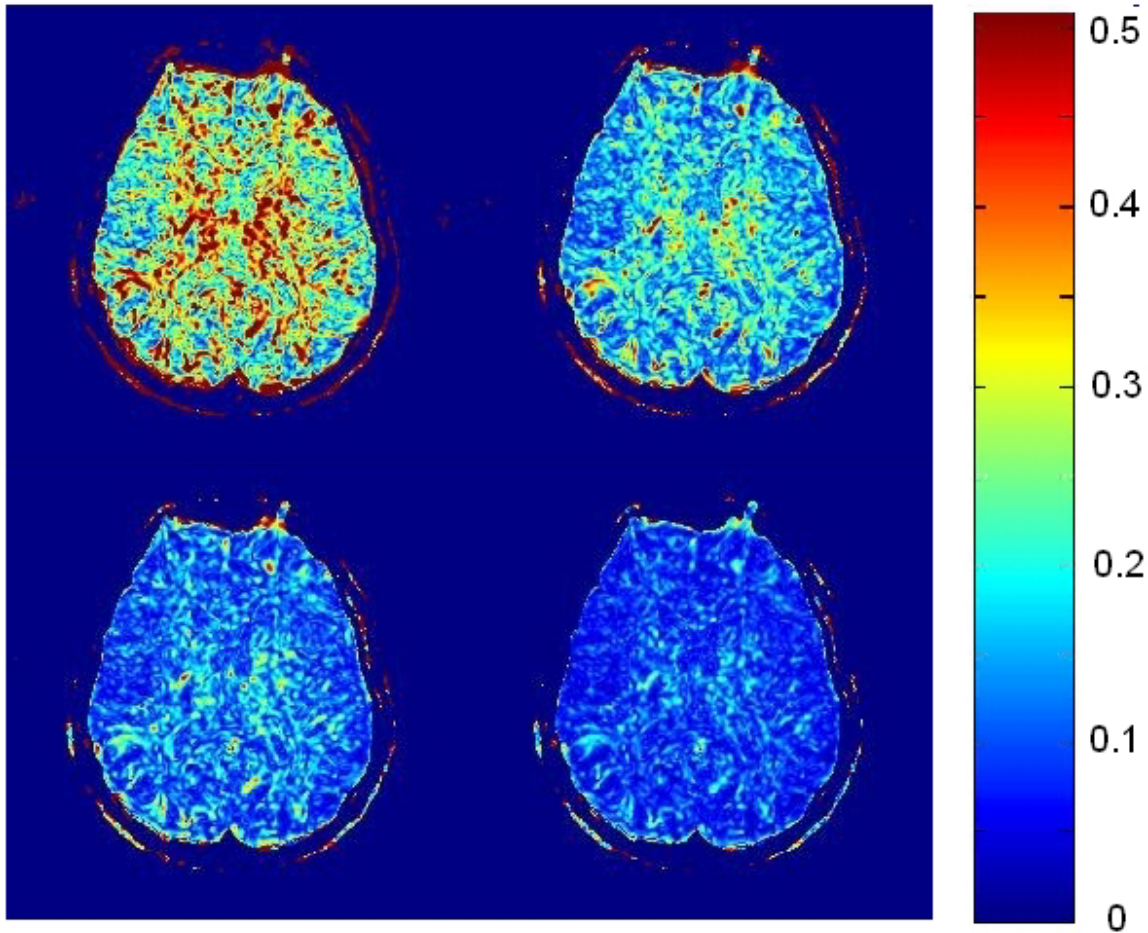


FA vs Number



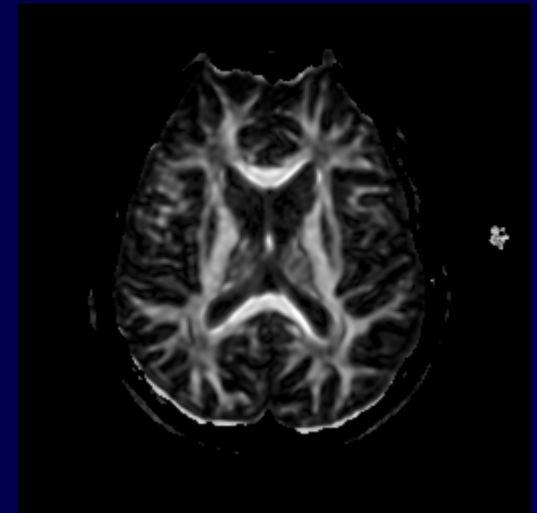
FA standard deviation map

Standard Deviation of the FA for the Data Sets Processed

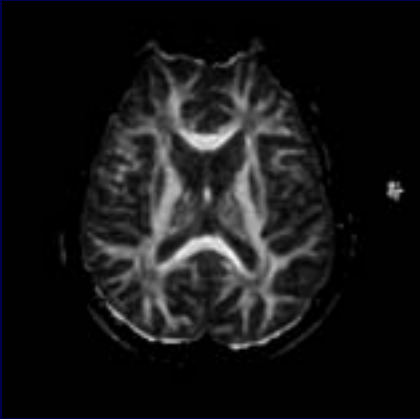


Top row: No averages (6), 2 averages (15)

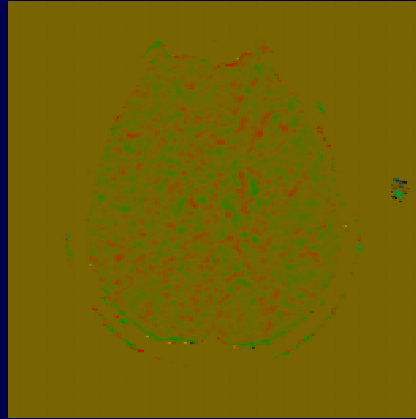
Bottom row: 3 averages (9), 4 averages (9)



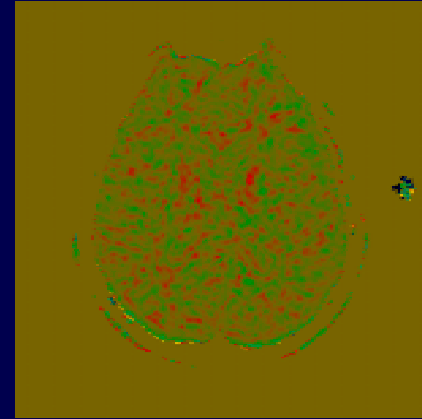
Changes in average FA values



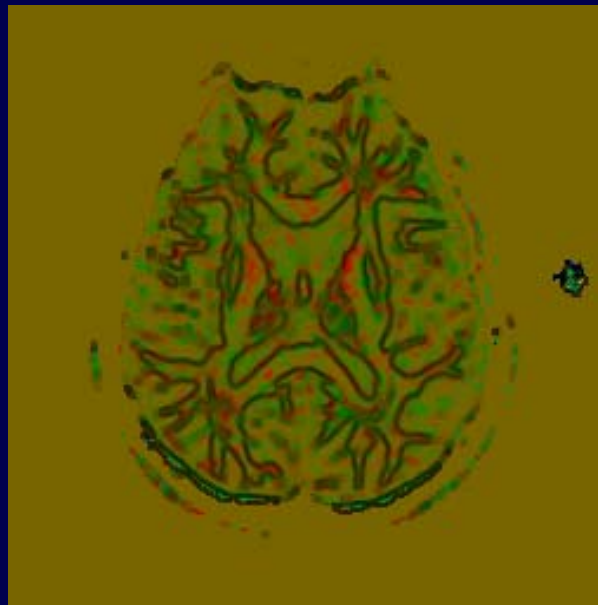
3 average



3 ave – 2 ave

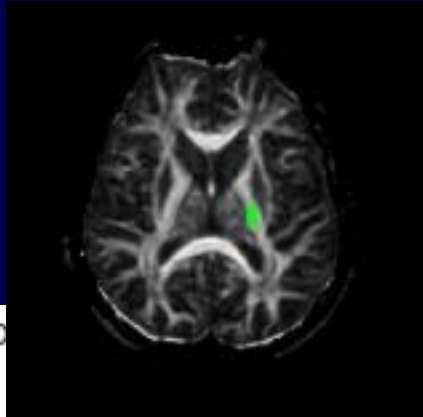


3 ave – 1 ave

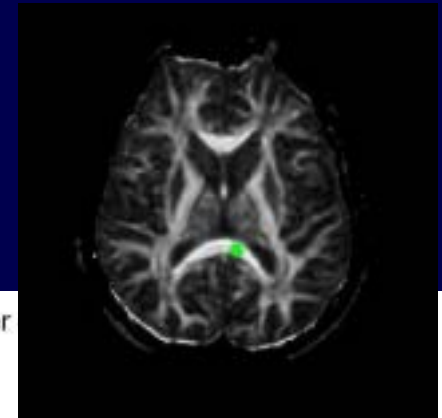
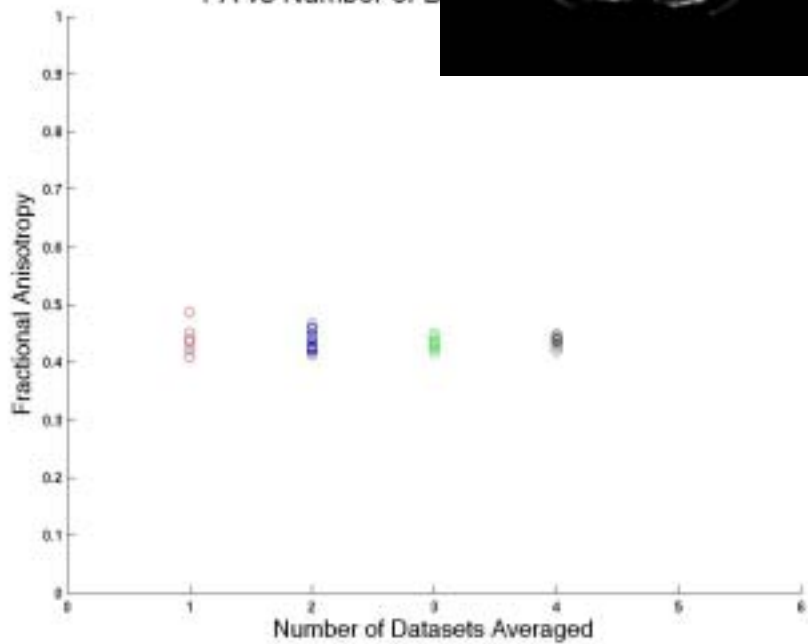


Plans, ideas, problems

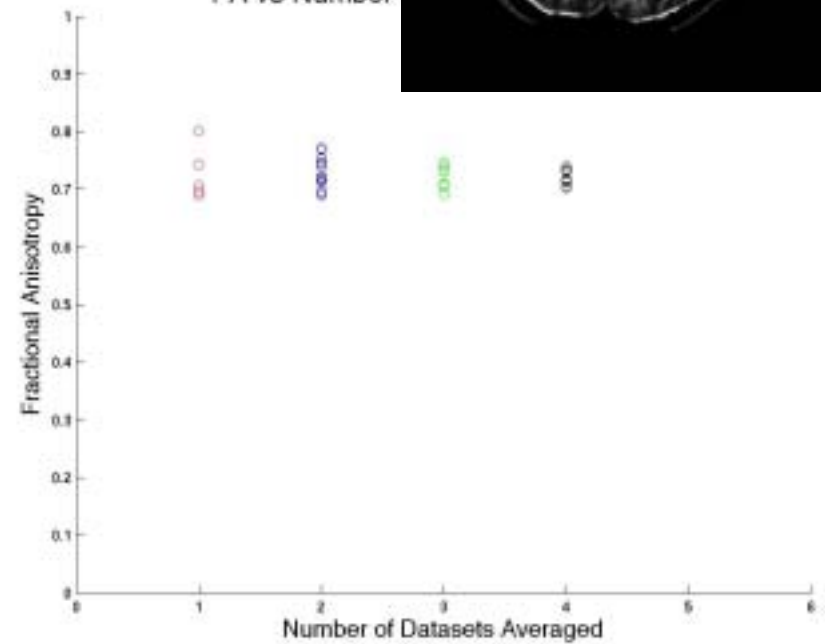
Repetition - FA



FA vs Number of D

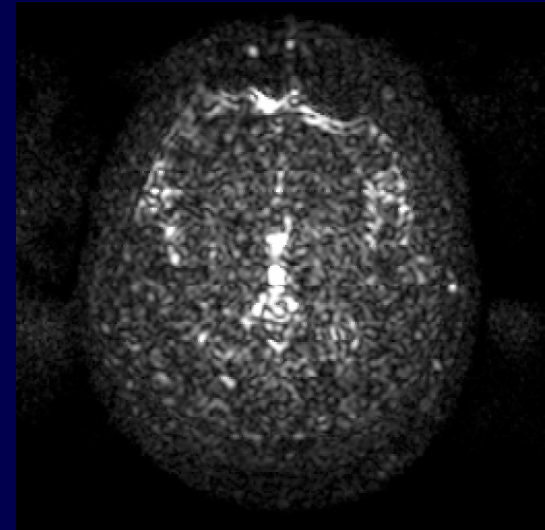
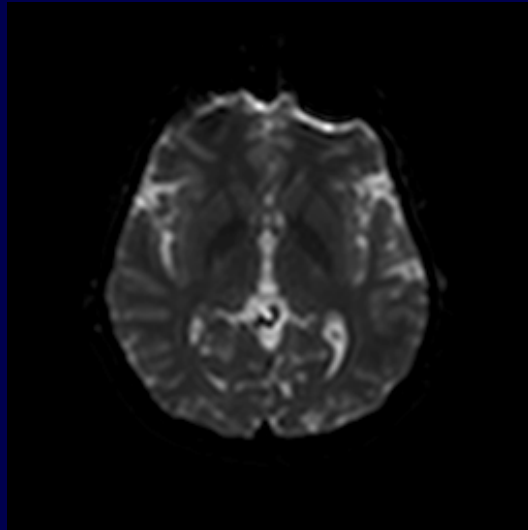


FA vs Number

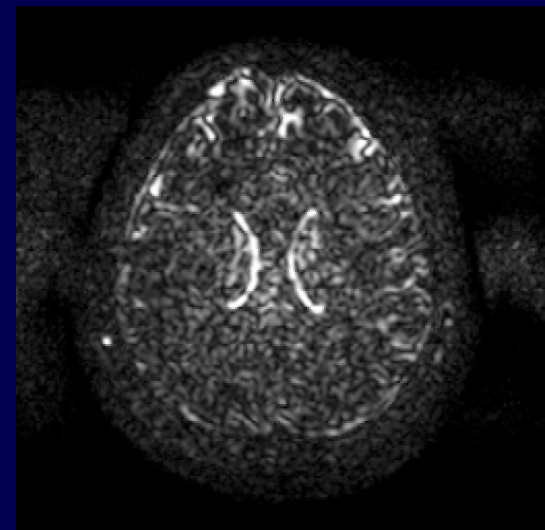
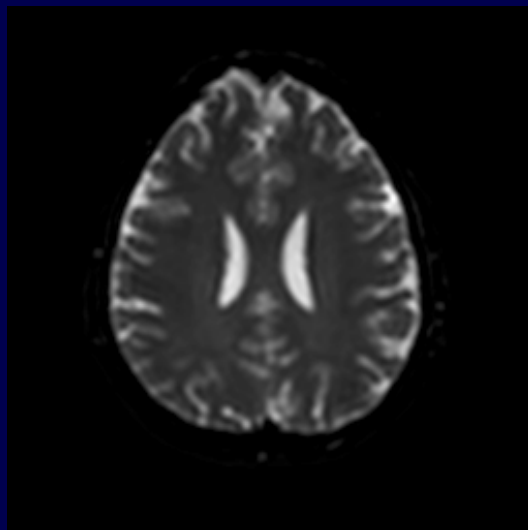


How can we define SNR?

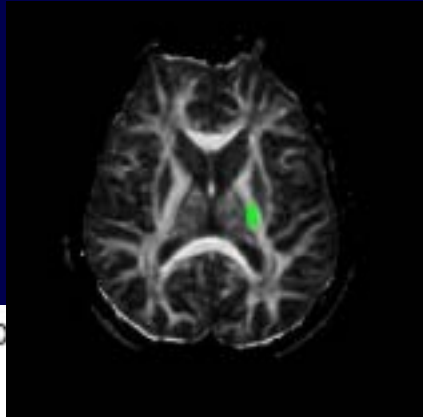
5 b0



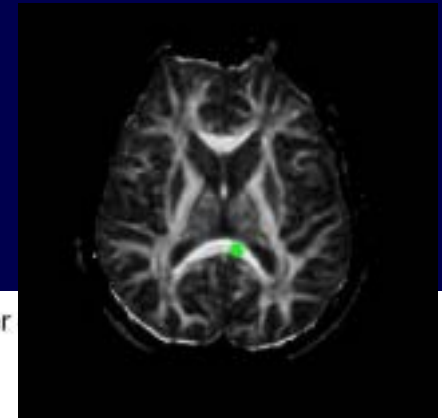
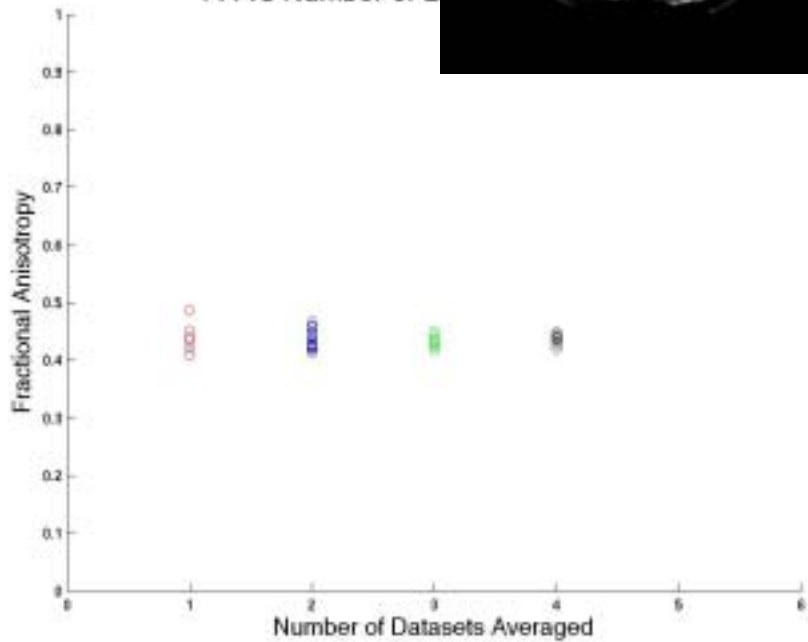
30 ori.



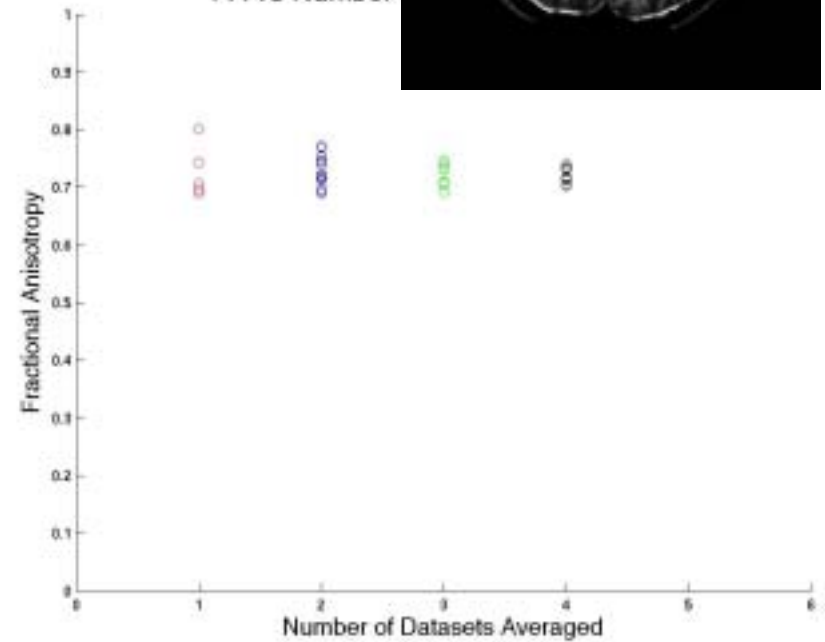
Repetition - FA



FA vs Number of D



FA vs Number

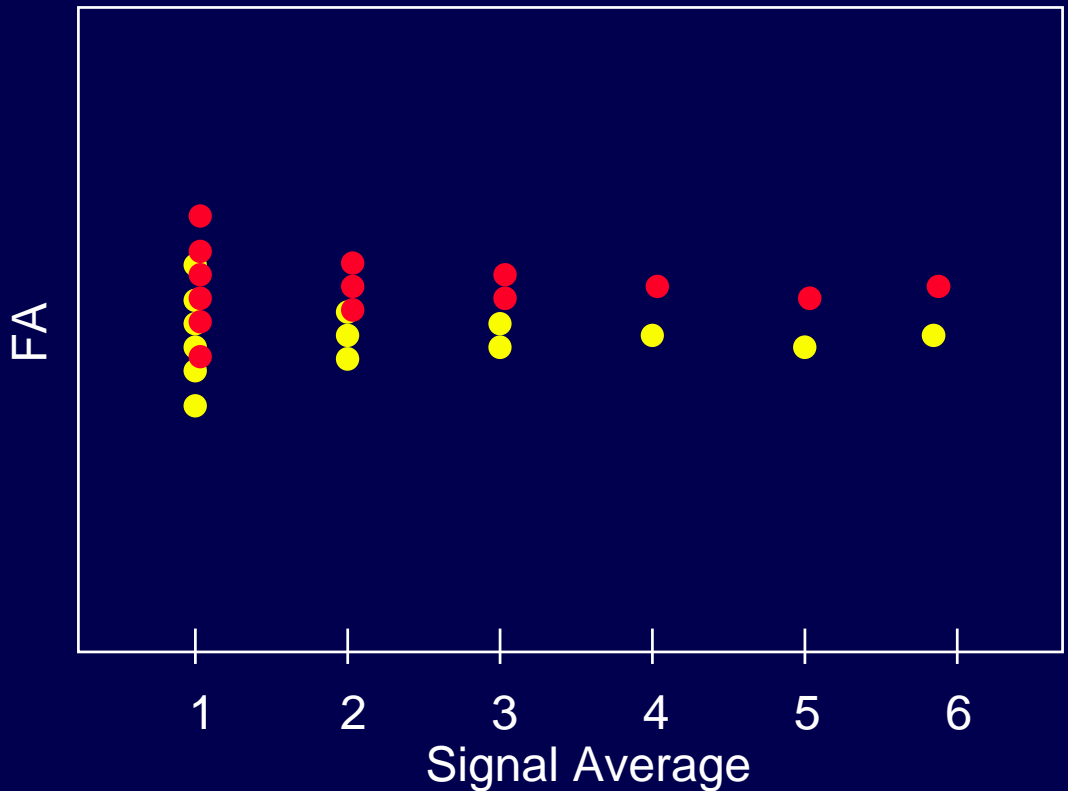


Sampling of lower SNR regions

5 b0	5 b0	5 b0	5 b0	5 b0	5 b0
30 ori.	30 ori.	30 ori.	30 ori.	30 ori.	30 ori.



2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0	2 b0
10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.	10 ori.



Orientation sub-sampling

5 b0

5 b0

5 b0

5 b0

5 b0

5 b0

30 ori.

30 ori.

30 ori.

30 ori.

30 ori.

30 ori.

15 ori.

15 ori.

10 ori.

10 ori.

10 ori.



More plans using the same datasets

- Reproducibility of tensor, fiber ori.
- Reproducibility of tracking
- Reproducibility of tracking-based MR parameter quantification
- Inter-measurement analysis
 - B0 distortion
 - Intra / inter-measurement variability comparison

Future Plan

- **TE analysis**
 - Fixed b (700) / variable TE (80 – 120 ms)
- **B-value analysis**
 - Fixed TE / variable b (500 – 2,000)
 - Shortest Te / variable b
- **Resolution**
 - Change FOV / change matrix size?
- **Inter-measurement analysis**
 - B0 distortion
 - Intra / inter-measurement variability comparison
- **SENSE / NO-SENSE?**

Phase II studies

- Recommendation of ranges of imaging parameters
- Common protocol
- Human phantom scans / Inter-institution variability