DTI Atlas Building and Statistical Analysis

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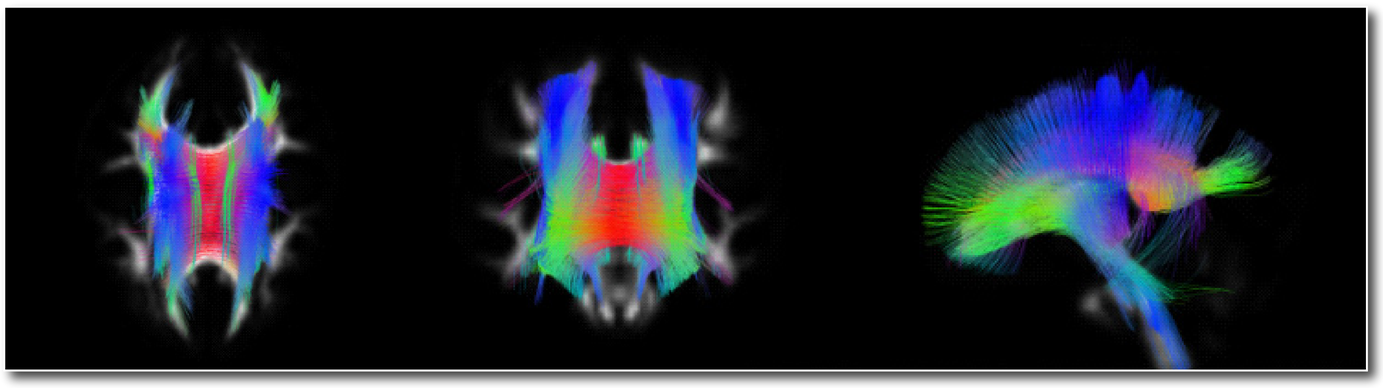
Goal

- Study the effect of various DTI measures with respect to age and gender.
- To study the effect of Marijuana on various white matter tracts.

Motivation

Diffusion tensor imaging (DTI)

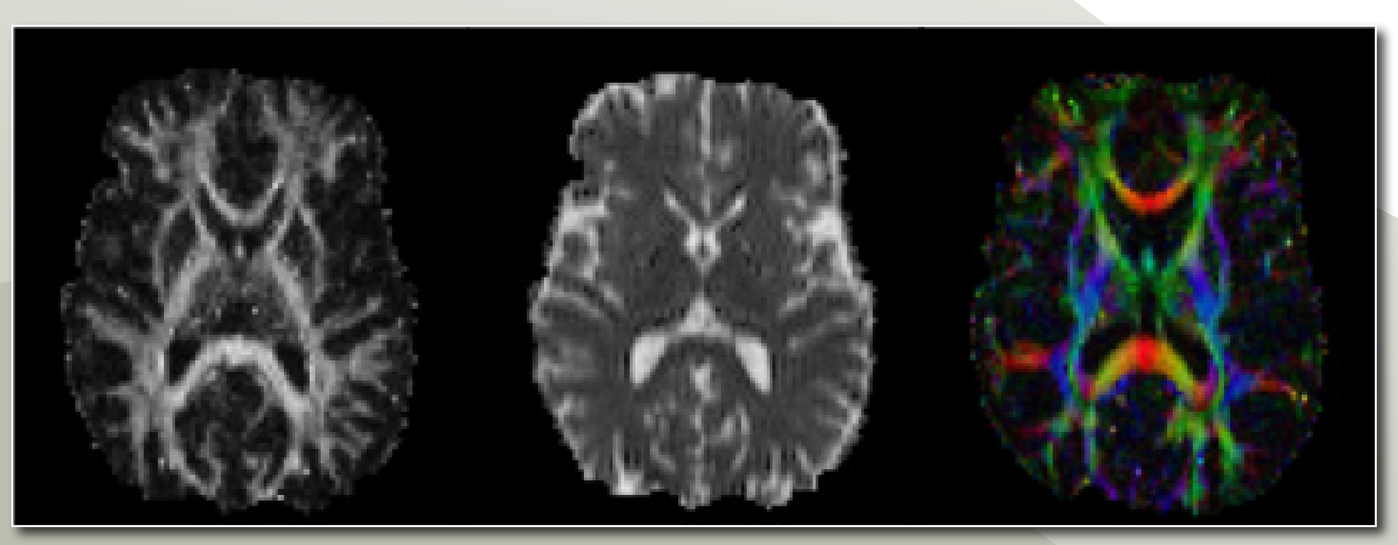
- A magnetic resonance imaging (MRI)-based neuroimaging technique.
- Helps visualize the location, the orientation, and the anisotropy of the brain's fiber bundles.
- Define neurological and psychiatric diseases and yield more-targeted treatments.



Visualization of fiber bundles

DTI Measures

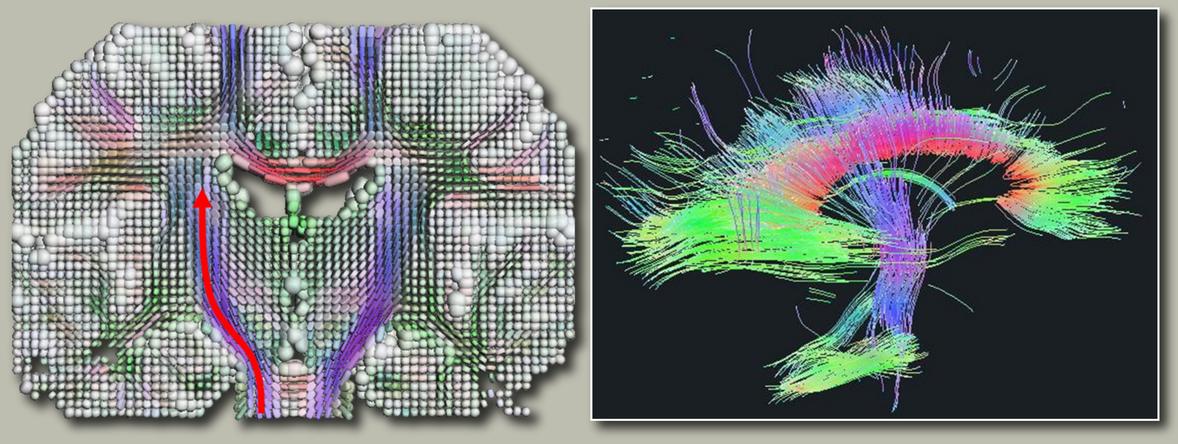
- Tensors characterize the anisotropic nature of water molecules.
- A scalar metric, defined form the tensor, provides quantitative information about tissue microstructure.
- The most prominent measures include fractional anisotropy (FA) and mean diffusivity (MD) and color fractional anisotropy (cFA).



FA image MD image colorFA image

Tractography

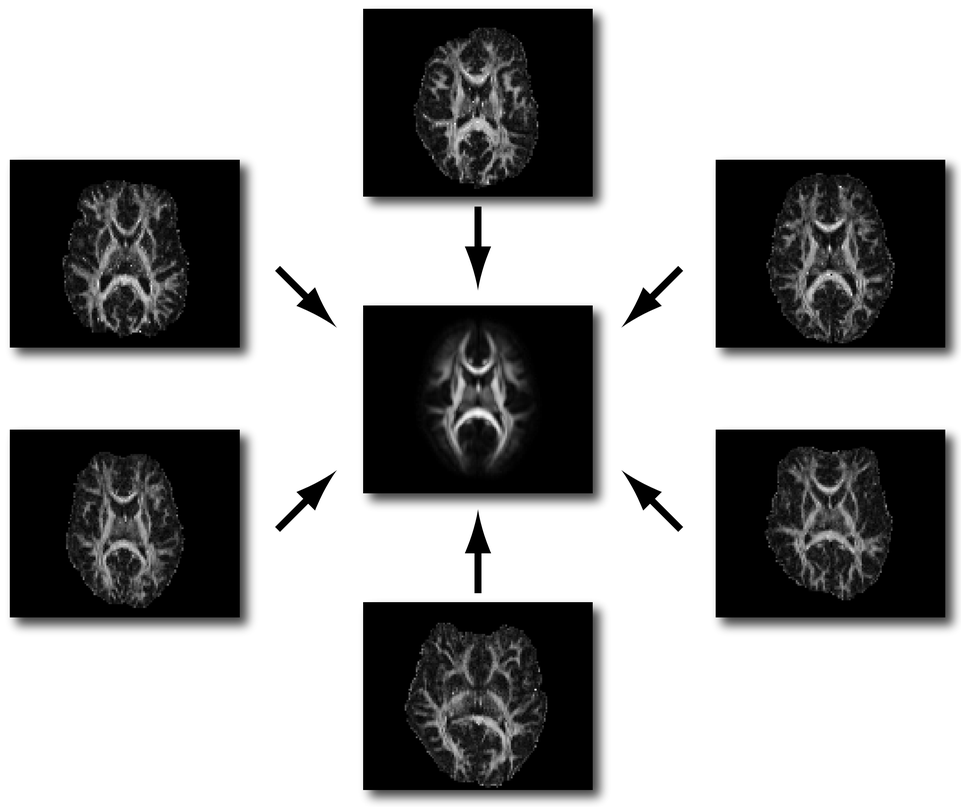
- Major tensor eigenvectors integrated using streamline tractography.
- Statistical analysis of derived measures is performed along fiber pathways.



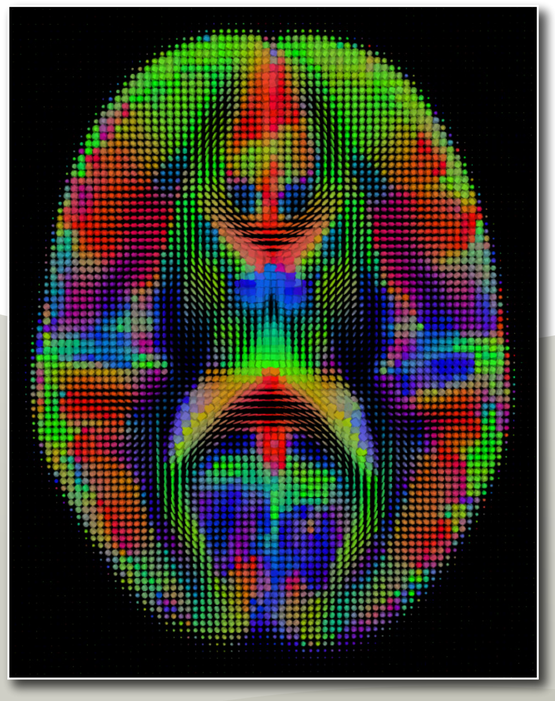
Tractography

DTI Atlas Building

- Map all the DTI images into a common reference frame.
- Use unbiased, deformable atlas building procedures to bring the population of DTI images into the common space.
- We use Riemannian framework to average tensors.



Atlas constructed from a population of DTI images



Averaged tensors

Tract-based Statistical analysis

To carry out group differences across population,

- ► Principal Component Analysis (PCA).
- ► Nonparametric permutation tests.

Software Tools Used

- *Slicer*: To convert DTI compatible file formats.
- *AtlasWerks*: To build DTI atlas.
- *DTIProcess*: To estimate tensors, calculate scalar measures, perform tractography.
- MedINRIA: To visualize tensors and fibers.

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