



Diffusion Tensor Analysis and Visualization for Neurosurgery

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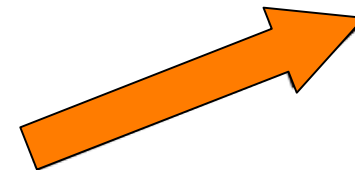
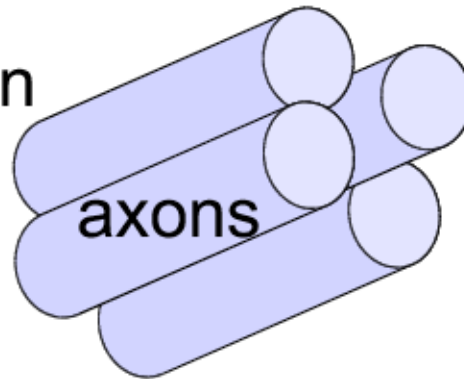
Alexandra J. Golby, M.D.



Diffusion MRI

- Measures water diffusion
 - Gives approximate fiber orientation

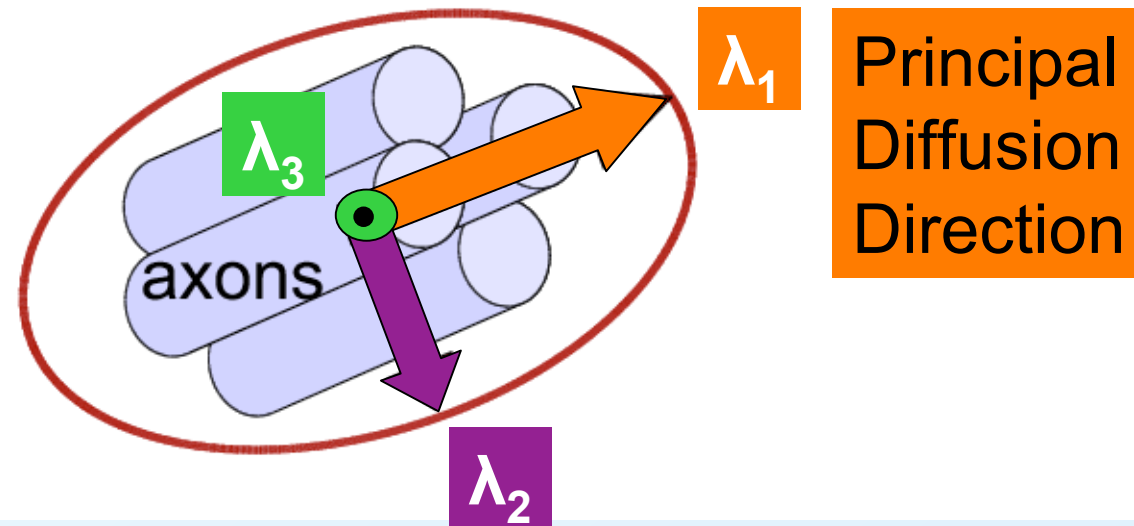
Slower diffusion
across fiber



Faster diffusion
along fiber

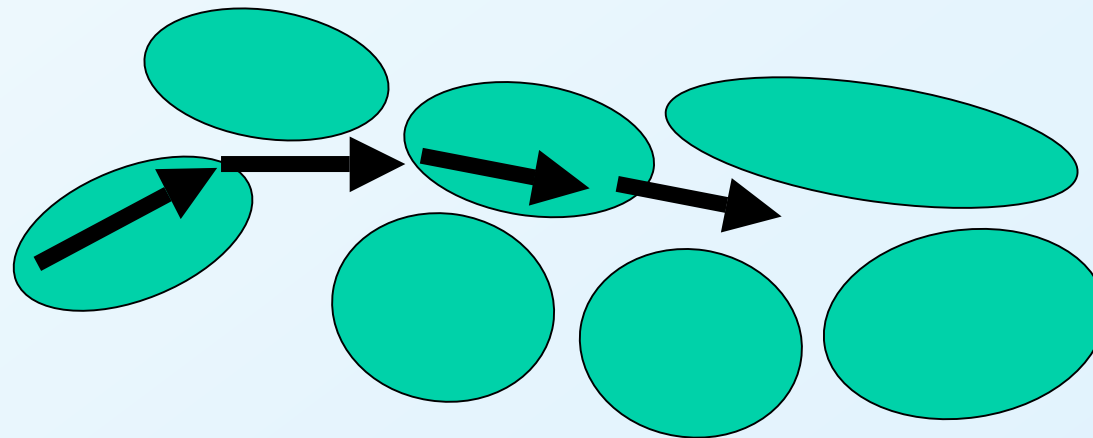
Diffusion Tensor MRI (DTI)

- Tensor model (Gaussian diffusion)
- 3x3 symmetric positive definite matrix
- Eigenvalues and eigenvectors



Tractography

- Estimate fiber trajectories in white matter
- Follow principal diffusion direction
- For neurosurgery:
 - Motor, language, vision
 - Corticospinal tract, arcuate fasciculus, optic radiation



Tractography Clustering

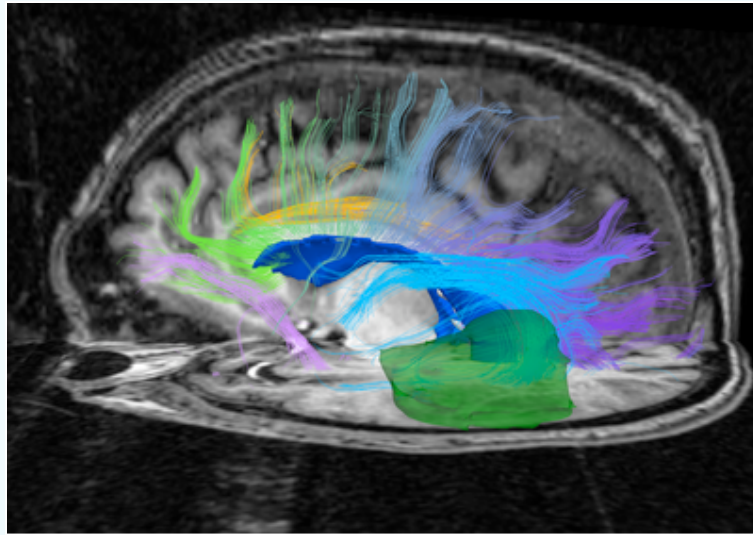
- Automatically group fibers into structures



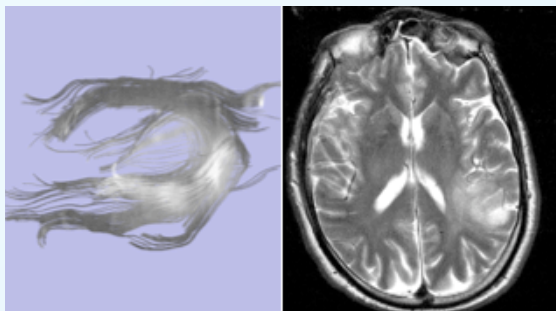
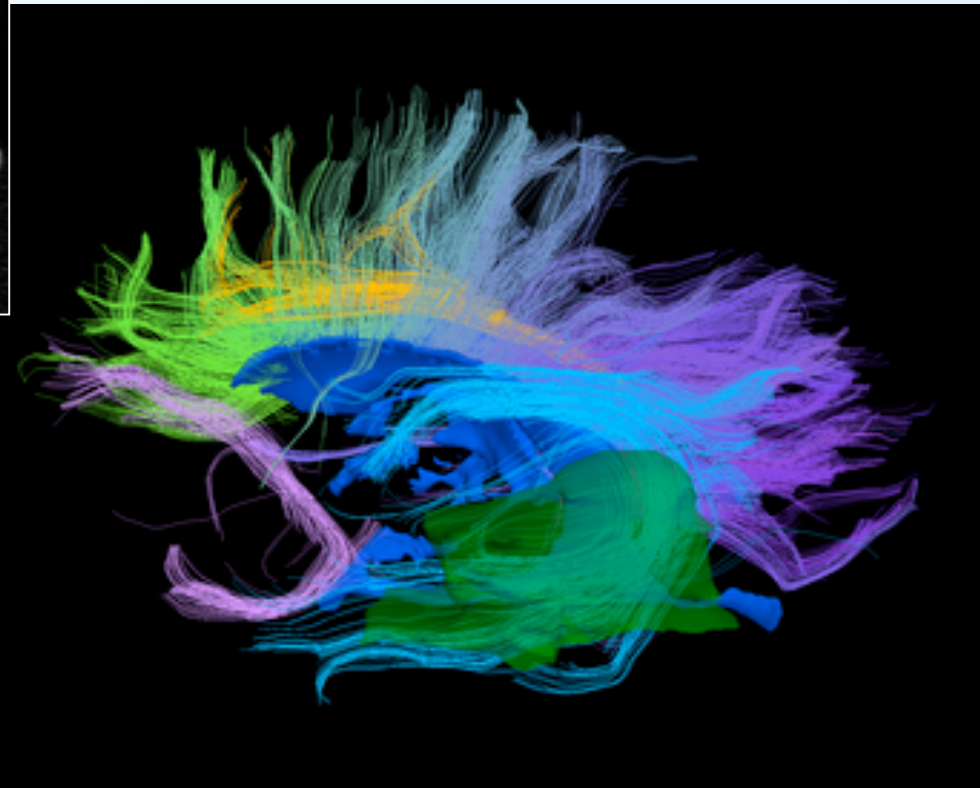
Lauren O'Donnell, Marek Kubicki, Martha E. Shenton, Mark E. Dreusicke, W. Eric L. Grimson, Carl-Fredrik Westin. *A Method for Clustering White Matter Fiber Tracts*. AJNR 27(5):1032-1036, 2006

Lauren O'Donnell and Carl-Fredrik Westin *Automatic Tractography Segmentation Using a High Dimensional White Matter Atlas* IEEE Transactions in Medical Imaging 26(11):1562-1575, 2007

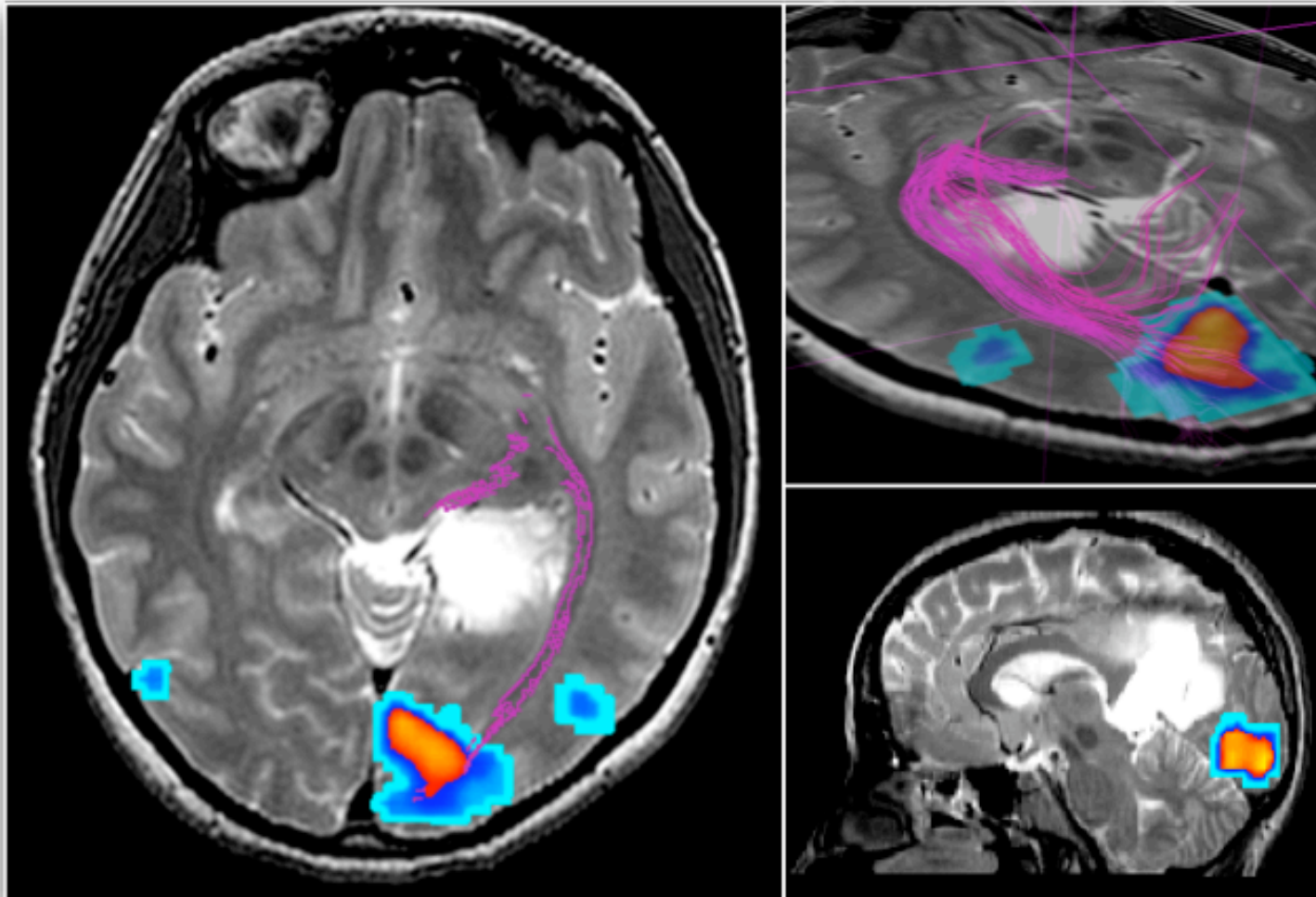
Tractography Clustering



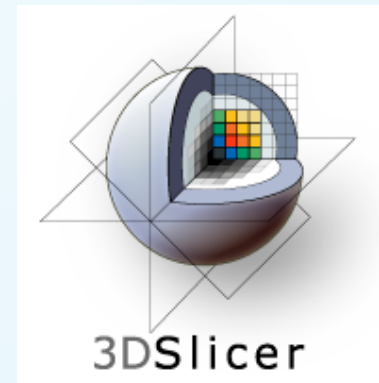
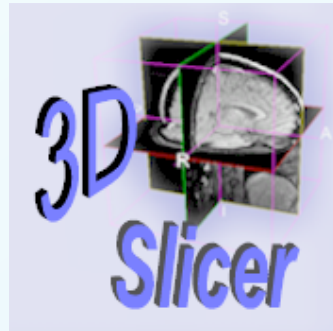
Surgical Case 1064



Tractography Clustering

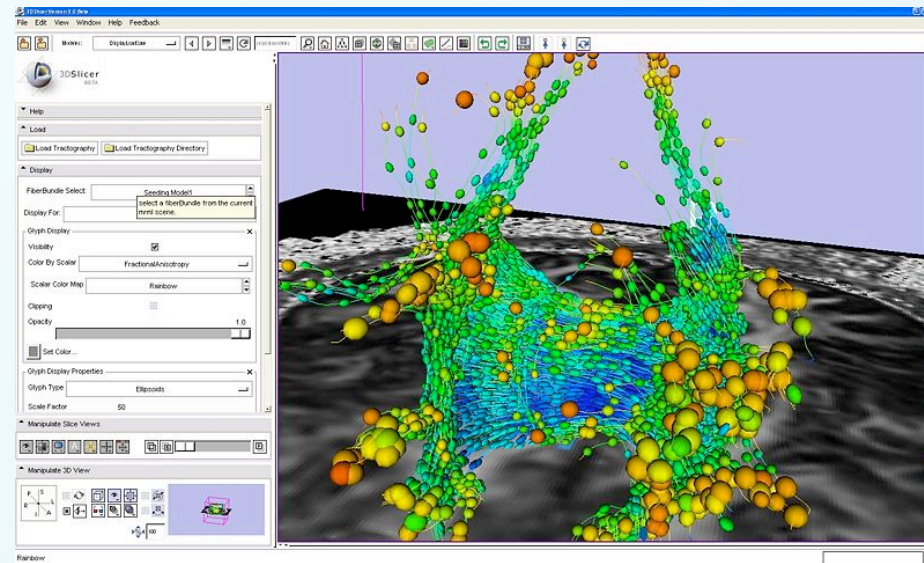


Slicer Platform



- Community effort
 - NA-MIC, NAC, BIRN and NCIGT
- National platform, federally funded
 - NCRRT, NIBIB, Roadmap, NCI, NSF, DOD and others.

Slicer Diffusion Tensor MRI

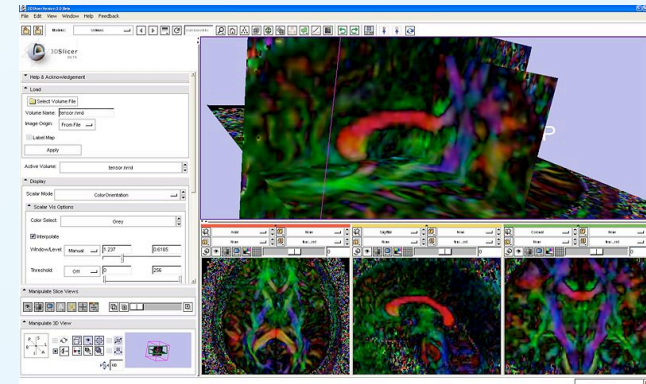


- NA-MIC, NAC and mBIRN
- LMI and SPL groups: 2001 to present
 - Lauren O'Donnell, Raul San Jose, Alex Yarmarkovitch, Steve Pieper
- <http://www.na-mic.org/Wiki/index.php/Slicer3:DTMRI>



Slicer Demo

- Registration
 - Tensor glyphs
 - Scalar maps (FA)
 - Tractography seeding
 - Tractography selection
 - Tractography conversion to voxels
-
- NRRD header





Slicer3

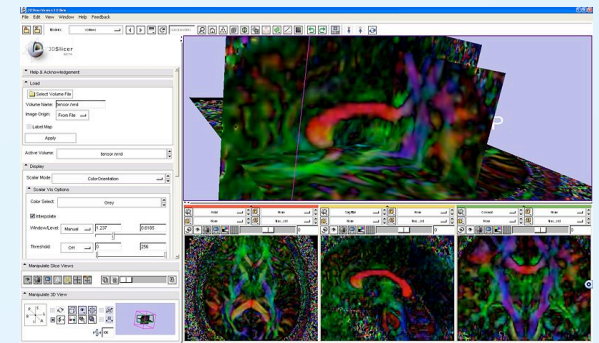
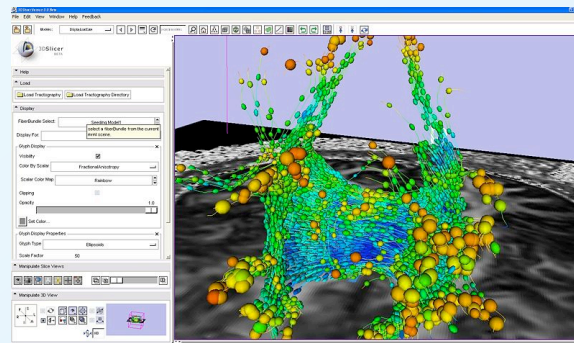
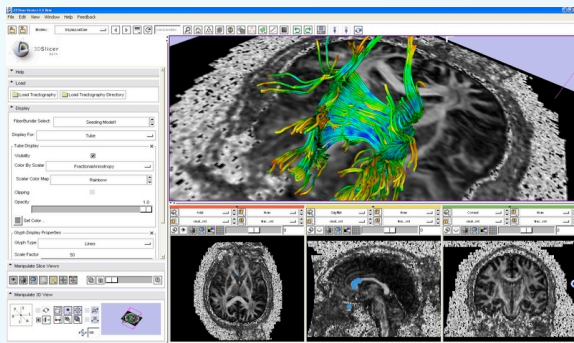
- Open source community software
- Improved software infrastructure
 - Integrated modules
 - Command-line modules (CLI)
- VTK, ITK based
- C++
- Beta Release
 - January 2008





Slicer3 DTI Visualization Modules

- Load/save DWI and DTI images as NRRD file
- Estimate tensors (based on teem library)
- Display DWI components and scalar invariants
- Seed tractography
 - From ROI or fiducial points





Community Involvement

- Slicer enabled research
 - http://www.slicer.org/pages/Slicer_Community
- NA-MIC project week
 - http://www.na-mic.org/Wiki/index.php/Engineering:Programming_Events
- Collaboration grants
 - <http://www.na-mic.org/Wiki/index.php/Collaborator:Resources>
- More information
 - www.slicer.org

