Open-source diffusion MRI for cancer research

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Diffusion MRI (dMRI)

- Only non-invasive probe of brain’s microstructure
- Measure water diffusion in many orientations using MRI
- Map brain connections
- Tractography
Neurosurgery for Brain Tumors

• Maximal tumor resection improves patient outcome
• dMRI: Map white matter tracts
• dMRI: Map brain microstructure
• dMRI is used for surgical planning and neuronavigation during surgery.
SlicerDMRI U01

• Create state-of-the-art dMRI workflows for brain cancer research.

• 3D Slicer: Open-source platform for visualization, surgical planning, surgical navigation, and medical image computing

• Latest improvements are available:
  • www.slicer.org
  • https://github.com/SlicerDMRI
Year 1: DICOM Tractography

- First implementation of the standard
- DCMTK: Open-source DICOM library
- Slicer DICOM I/O module
- DICOM <-> major research formats
- Future interoperability with commercial neurosurgical neuronavigation!
Research: Tractography for Neurosurgery

- Tractography challenges: crossing fibers, edema, displacement
- Analysis challenge: identify key tracts from 100,000’s of fibers
Challenge: Crossing Fibers

- Clinical method: Diffusion tensor (DTI)
- Models one tract per voxel
- Multi-fiber models needed [1] [2]

Challenge: Edema

- Peritumoral edema increases water around tumor
- Changes dMRI signal
- Increases difficulty of tractography
Robustness to crossings, edema

![Graph showing volume of corticospinal tract](image)


Challenge: Identification of Important Tracts

- Brain is highly connected: 100,000’s of “fibers”
- Current clinical method: interactive selection of fibers

Open-source tools for dMRI

www.slicer.org
tractography visualization, dMRI quantification, anatomical hierarchies

github.com/SlicerDMRI

multi-fiber tractography

github.com/pnlbwh/ukftractography

tract clustering and registration

github.com/SlicerDMRI/whitematteranalysis
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