DTI Atlas Building – Santa Fe

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Overview

- Algorithm [1]
- Inputs
- Geometry of atlas fibers
- Diffusion statistics
- Results, conclusions, and thoughts
Inputs

- Larger data set
- Image data
  - Scanner resolution
  - No distortion correction
Preprocessing

- Tensor estimation – DTIProcess from NeuroLib
  - Weighted least squares (3 iterations)
  - Background threshold 350
  - Time: 3-4 minutes per
- FA/MD/Color FA computation using DTIProcess
- Maximum eigenvalue image (sigma = 4.5 mm)
- ~minutes per-image, Xeon dual-core w/ 2GB (Memory is limiting factor for processing)
Registration

- Average baseline image registered to T2 atlas
  - RView
  - Cross-Correlation
  - 3 resolution levels
- Affine registration used as initialization for fluid registration (Joshi, Davis) [2]
  - Multi-resolution (3 levels)
  - Runs in ~15 minutes on 8 core machine 64 GB RAM
Fiber Tracking

- Computed on atlas tensor image
- ROIs redrawn in atlas based on sample ROIs
  - InsightSNAP 1.5.4 with FA and/or Color FA images
  - Arcuate drawn based on Susumu Mori's atlas
- FiberTracking 2.3.1 used with default parameters
Collection of Diffusion Statistics

- FiberViewer 1.2.3 used for clustering/analysis
- Fiber process command line tool in DTIProcess
- For each point in atlas bundle lookup data from individual image
- For each bundle project collected data onto 1-d curve via arc-length parameterization. Median of data in cross-section
  - FA
  - MD
Analysis of Tract Statistics

- FiberViewer used to reduce each individual fiber bundle to 1-d function (median statistic)
- Population (N images) collected into spreadsheet NxM (m == # of samples along tract)
- Analysis done using scipy, numpy
- Functional Data Analysis [3]
  - Smoothing
  - PCA
  - point-wise tests (multiple comparison correction)
Internal Capsule

left

right
Cingulum

left

right
Arcuate
Arcuate
Fornix
Fornix
Quick Quality Check of Atlas

caseD00922

Top: Left cingulum bundle (Sagittal View)
Right: Left cingulum bundle (Coronal View)
Quick Quality Check of Atlas

caseD00939

Left: Right Uncinate (from Anterior)
Top: Right Uncinate (from Right)
Left Internal Capsule
Left Internal Capsule

FA

MD
Left Internal Capsule

FA

MD

mean

PC - 1

PC - 2

PC - 3
Left Internal Capsule

FA

MD
Right Internal Capsule
Right Internal Capsule

FA

MD
Right Internal Capsule

FA

MD
Right Internal Capsule

FA

MD
Left Arcuate
Left Arcuate

FA

MD
Left Arcuate

FA

MD
Left Arcuate

![Graphs showing FA and MD for SZ and NC groups.](image-url)
Right Arcuate
Right Arcuate

FA

MD
Right Arcuate

FA

MD
Right Arcuate
Left Cingulum
Left Cingulum

FA

MD
Left Cingulum
Left Cingulum

FA

MD
Right Cingulum
Right Cingulum

FA

MD
Right Cingulum

FA

MD
Right Cingulum

FA

MD

+ SZ

- NC

-2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0

-2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0
Left Uncinate
Left Uncinate

FA

MD
Left Uncinate

FA

MD
Left Uncinate

FA

MD
Right Uncinate
Right Uncinate

FA

MD
Right Uncinate

FA

MD
Right Uncinate

FA

MD
Results

- Lateralization in Internal Capsule, Cingulum,
  - Possibly due to atlas procedure especially in cingulum
  - Possibly in original data especially in internal capsule
- No statistically significant diffusion differences
- We want to compare the atlas results with individual manual processing
References

