Team1: Reconstruction of diffusion MRI based fiber orientation

Team members: Saiyam Bherulal Jain, Sandeep Raj Sagaya Raj and Mounika Kommi

Sub-Task 1.

a) Pre-process the given diffusion MRI data for de-noising and distortion/motion correction
b) Perform the tensor based reconstruction of the pre-processed data using Diffusion Tensor Imaging (DTI)
c) Fit the estimated tensor orientation in the form of glyphs on the pre-processed data
d) Evaluate the performance of tensor based reconstruction and fitting based on:
    - Number of sampling directions
    - Number of crossing/non-crossing fibers resolved

Sub-Task 2.

e) Perform the sampling based reconstruction on the pre-processed data using Generalized Q-Sampling Imaging (GQI)
f) Fit the estimated fiber orientation in the form of glyphs on the pre-processed data
g) Evaluate the performance of sampling based reconstruction and fitting based on:
    - Number of sampling directions
    - Number of crossing/non-crossing fibers resolved

Sub-Task 3.

h) Perform the diffeomorphic reconstruction on the pre-processed data using Q-Space Diffeomorphic Reconstruction (QSDR)
i) Fit the estimated fiber orientation in the form of glyphs on the pre-processed data
j) Evaluate the performance of diffeomorphic reconstruction and fitting based on:
    - Number of sampling directions
    - Number of crossing/non-crossing fibers resolved

Literature:

[1] https://www.sciencedirect.com/science/article/pii/S1064186684710375

[2] https://www.semanticscholar.org/paper/Dataset-independent-reconstruction-of-high-angular-Yeh-Wedeen/0e06dd3f758e85d30c4609e2ea3c1244abe86aa7

[3] https://www.ncbi.nlm.nih.gov/pubmed/21704171

Team2: Visualisation of tractography based fiber tubes

Team members: Alaleh Kamel, Yu Kong, Zihan Zhang and Susu Hu

Sub-Task 1.

a) Import and environment transfer of the given tractography data
b) Implementation of a real time tube rendering algorithm using raycasting
c) Evaluation of the rendering algorithm based on accuracy and latency

Sub-Task 2.

d) Implementation of robust color/texture mapping and ambient occlusion for better tube trajectory visualisation
e) Evaluation of the color/texture mapping based on accuracy, latency as well as visual quality derived from user study

Sub-Task 3

f) Implementation of ambient occlusion for better structural perception of the tubes
g) Evaluation of the ambient occlusion algorithm based on accuracy, latency as well as visual quality derived from user study

Sub-Task 4.

h) Implicit and explicit synchronization of the tube rendering pipeline
i) Selection of the viewpoints for robust visualisation of crossing/non-crossing tubes

Literature:

[1] https://ieeexplore.ieee.org/document/8637778

[2] https://old.cescg.org/CESCG-2005/papers/VRVis-Scharsach-Henning.pdf

[3] https://www.ncbi.nlm.nih.gov/pubmed/22689079

Team3: Tractography based visual diagnostics

Team members: Raveen Venkat Raj Reddy, Lucas Waclawczyk, Nils Hoffmnn and Elizaveta Soldatova

Sub-Task 1.

a) Pre-process the given diffusion MRI data for de-noising and distortion/motion correction
b) Registration of the given diffusion MRI data based on similar age, gender, healthy controls and Alzheimer (AD) subjects.

Sub-Task 2.

c) Implementation of a deterministic or probabilistic fiber tracking to obtain whole brain fiber tracts by performing joint seeding of registered subjects
d) Segmentation of temporal lobe region of the brain to obtain Region of interest (ROI)

Sub-Task 3.

e) Filtering of the whole brain fiber tracts to obtain segmented fibers specific to ROI
f) Visual diagnosis of fiber tracts based on age, gender and existent/non-existent of AD.

Sub-Task 4.

g) Quantitative evaluation of loss of white matter in AD subjects compared to healthy subjects by performing:
    - Voxel based analysis (VBA)
    - Tract based spatial statistics (TBSS) and
    - Fixel based analysis (FBA)

Literature

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4084691/

[2] https://kilthub.cmu.edu/articles/Deterministic_diffusion_fiber_tracking_improved_by_quantitative_anisotropy_/6614264

[3] https://www.ncbi.nlm.nih.gov/pubmed/29309541