Introduction. Motivation

• Parkinson’s Disease (PD) affects population that has on average over 61 years [5], even if it can be detected on people over 40 years. The disease is detected when over 80-90% of the dopamine is lost [1] [2].

• Current PD patients are diagnosed based on specific cognitive tests. The scores obtained at these tests rank the patients on a severity scale (e.g., UPDRS scale or H&Y scale) [8] [3].

• Incorporating the image information when evaluating the severity of the disease actually introduces the manifestation of PD at the physical level, consequently completing the cognitive tests. Trembling is one of the disease effect and it is the result of the dopamine lost on the motor tracts [3]. Evaluating these tracts, we can evaluate the disease severity and correlate it with the cognitive scale.

• Medical Image Database: 42 cases underwent DTI imaging with TR/TE 4300/90; 12 directions; 4 averages; 4/0 mm sections; 1.2 x 1.2 mm in-plane resolution, after giving informed consent [11].

• From the DTI sequences EPI and FA images are processed for automatic extraction of the volumes of interest (VOIs) and EPFs provide the tensor information for the tracking algorithms as well.

• PD offers the motivation for our system, the solution for the problems are in the technical aims

PD patients trembling - Dopamine lost in stratiographic tracts

Find the stratiographic tract

Track the fibers

Evaluate tracts on each side of the brain

Determine the source and destination of the tracts

Detect the volumes of interest

- We acquire the DICOM images from the medical CD and select the EPI and FA sequences. From the header we procure all the needed demographic information for the analysis. The output for us represents the fibers from the stratiographic tract and their evaluation –density and volume.

- We envision several steps for extracting the VOIs.

- Automatic detection of the registration parameters

- Detect the stratiographic tract when growing the fibers

- Evaluate the fibers on their density and volume

- When we detect the information from the FA and EPI an informational fusion takes place because it implies for us putting together the tensor information from EPs with the detected VOI from the FA image.

Conclusion & Future research interest

- From the medical point of view the system offers the possibility to determined merge the cognitive and image extracted values. By evaluating the variation of the fibers on the H&Y scale we can determine if that extrapolated offers values of the fibers on the early cases – prediction function.

- From the technical point of view the overall approach fuses the information from two different DTI images and makes an automatic VOI detection of the PD specific elements as an atlas does. It manages to eliminate the demographic elements when performing the detection.

- The algorithm used for detection of the midline between the two hemispheres can be used for limitation and comparison in stroch research.

- Using the same approach we can detect specific volumes for other diseases and even envision an algorithm for detection of a complete atlas that offers independence on the patient's demographic parameters.

The fiber detection algorithm can also be used for acquiring other bundles of interest

Medical and technical results

- The software was tested on Intelle core Quad CPU G660 (2.4Ghz; 4.0G RAM) and the average time for each patient was 4.68 mm with the automatic detection and fiber growth algorithm

- PDFibAtlas is implemented using image toolkit and the bio-medical imaging plug-ins; the statistical evaluation is performed with WinSPC (Statistical Process Control toolkit).

- We require that the demographic parameters do not affect the testing and/or the statistical results, so we make 4 test batches with random cases (16 patients and 16 control cases)

- The ANOVA test proved to be immune to the demographic elements and showed a strong correlation between the H&Y value and the fiber density, especially on the left side of the brain, whereas PD seems usually to affect more the tracts

Model design. PDFibAtlas overview

- We envision several steps for extracting the VOIs:

- Automatically find the slice of interest independent on the patient’s demographic components (volume specific elements based the etic provenance of the patient, sex and/or age)

- Find the place on the slice of interest, without using an atlas, where to apply the automatic volume growing algorithm

- Make the distinction between the hemispheres of the brain

- Grow the VOI on the stack on both sides of the brain

- Using two image tests – EPI and FA – implies Registration:

  - Rigid body registration

  - Geometry-based transformation

- Automatic detection of the registration parameters

- Detect the stratiographic tract when growing the fibers

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References


