Title:

Atlas-Based Segmentation of White Matter Fiber Bundles Using ODF Data in Reduced Position Orientation Space (RPOS)

Authors & affiliations:

Esmaeil Davoodi-Bojd[1], Mohammad-Reza Nazem-Zadeh[1], Hamid Soltanian-Zadeh[1,2]

[1] Control and Intelligent Processing Center of Excellence, School of Electrical and Computer Engineering, University of Tehran, Tehran 14395-515, Iran
E-mails: es.davoodi@ece.ut.ac.ir, m.nazemzadeh@ece.ut.ac.ir, hszadeh@ut.ac.ir
[2] Image Analysis Laboratory, Radiology Department, Henry Ford Hospital, Detroit, MI 48202, USA, E-mail: hamids@rad.hfh.edu

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Introduction: Reference [1] introduced a five-dimensional Position Orientation Space (POS) for revealing fiber bundle tracts from the Orientation Diffusion Function (ODF) data acquired by the HARDI methods. However, the POS is applicable only in low resolution datasets due to the large number of ODF measures corresponding to the gradient directions. Therefore, we introduce a reduced space, called RPOS, in which four major directions are considered such that they have the overall effect of all directions. Initial fibers are defined for the algorithm using an atlas of fiber bundles.

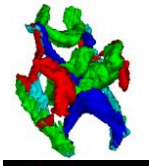
Methods: The atlas is registered to the subject by our proposed method using principal eigenvector and FA data [2]. After preparing the initial fibers, four major directions are computed from the ODF data to build the RPOS in which there are four sites in each voxel, labelled as belonging to a desired fiber or not. The labelling process is similar to [1] which uses Markov Random Field in the optimization process.

Results: We evaluated the proposed RPOS method using simulated and real data. We used an atlas with 18 segmented fibers [2] (Fig. 1). Registered atlas provided initial fibers (Fig. 2) for the algorithm to generate the final segmented fibers (Fig. 3). Our experiments show superiority of RPOS to POS, especially in noisy and crossing regions.

Discussion: We have developed and evaluated an atlas-based method for the segmentation of the white matter fiber bundles. The main contribution of the proposed method is encapsulating the diffusion data in four major ODF directions. Moreover, the initial guesses of the fibers are computed from an atlas. These strategies have made the proposed method reliable and robust to noise.

Fig. 1. Atlas Fibers.

Fig. 2. Registered atlas fibers to the subject.



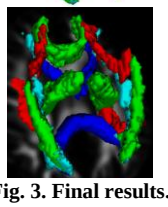


Fig. 3. Final results.

References :

[1] Hagmann et al. NeuroImage 32: 665-675 (2006).
[2] Davoodi-Bojd et al. ISBI2008. 879-882 (2008).