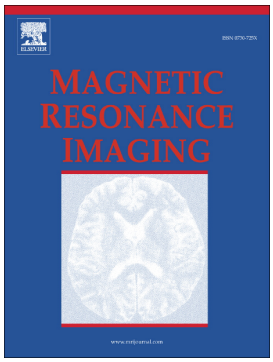

Learning-based structurally-guided construction of resting-state functional correlation tensors

Lichi Zhang, Han Zhang, Xiaobo Chen, Qian Wang, Pew-Thian Yap, Dinggang Shen

PII: S0730-725X(17)30126-1
DOI: doi: 10.1016/j.mri.2017.07.008
Reference: MRI 8795

To appear in:

Received date: 19 January 2017
Revised date: 22 May 2017
Accepted date: 13 July 2017

Please cite this article as: Lichi Zhang, Han Zhang, Xiaobo Chen, Qian Wang, Pew-Thian Yap, Dinggang Shen , Learning-based structurally-guided construction of resting-state functional correlation tensors, (2017), doi: 10.1016/j.mri.2017.07.008

Learning-Based Structurally-Guided Construction of Resting-State Functional Correlation Tensors

Lichi Zhang[a], Han Zhang[a], Xiaobo Chen[a], Qian Wang[b,*], Pew-Thian Yap[a], Dinggang Shen[a,c,*]

[a]*Department of Radiology and BRIC, University of North Carolina at Chapel Hill*
{lichi, pewthian_yap, dgshen}@med.unc.edu, {napoleon1982, xbchen82}@gmail.com
[b]*Med-X Research Institute, School of Biomedical Engineering, Shanghai Jiao Tong University*
wang.qian@sjtu.edu.cn
[c] *Department of Brain and Cognitive Engineering, Korea University, Seoul 02841, Republic of Korea*
** Corresponding authors*

Abstract

Functional magnetic resonance imaging (fMRI) measures changes in blood-oxygenation-level-dependent (BOLD) signals to detect brain activities. It has been recently reported that the spatial correlation patterns of resting-state BOLD signals in the white matter (WM) also give WM information often measured by diffusion tensor imaging (DTI). These correlation patterns can be captured using functional correlation tensor (FCT), which is analogous to the diffusion tensor (DT) obtained from DTI. In this paper, we propose a noise-robust FCT method aiming at further improving its quality, and making it eligible for further neuroscience study. The novel FCT estimation method consists of three major steps: *First*, we estimate the initial FCT using a patch-based approach for BOLD signal correlation to improve the noise robustness. *Second*, by utilizing the relationship between functional and diffusion data, we employ a regression forest model to learn the mapping between the initial FCTs and the corresponding DTs using the *training data*. The learned forest can then be applied to predict the DTI-like tensors given the initial FCTs from the testing fMRI data. *Third*, we re-estimate the enhanced FCT by utilizing the DTI-like tensors as a feedback guidance to further improve FCT computation. We have demonstrated the utility of our enhanced FCTs in Alzheimer's disease (AD) diagnosis by identifying mild cognitive impairment (MCI) patients from normal subjects.