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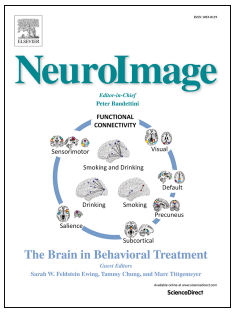

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Surface-Enhanced Tractography (SET)

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Abstract

In this work, we exploit the T1 weighted image in conjunction with cortical surface boundary to improve the precision of tractography under the cortex. We show that utilizing the cortical interface and a *surface flow*, to model the superficial white matter streamlines, enhance and improve tractography trajectory near the cortex. Our novel *surface-enhanced tractography* reduces the gyral bias, the length bias and the amount of false positive streamlines produced by tractography. This method improves the reproducibility and the cortical surface coverage of tractograms which are crucial for connectomics studies. The usage of cortical surfaces, extracted from the standardly acquired 1mm isotropic T1, is a straightforward and effective way to improve existing tractography processing pipelines and structural connectivity studies.

Keywords: Diffusion MRI, Discrete Differential Geometry, White Matter, Connectome, Gyrification, Tractography, Gyral Bias

1. Introduction

Diffusion MRI (dMRI) is a non-invasive technique that allows the reconstruction of the white matter (WM) structure. Axonal pathways can be reconstructed in-vivo by following the local orientation of the water diffusion with a process called tractography. This in-vivo reconstruction of the white matter can be used for structural connectivity studies [Wakana et al., 2007; Hagmann et al., 2007; Fornito et al., 2013]. Structural connectivity mapping (connectomics) can be estimated through streamline endpoints produced by tractography [Yo et al., 2009; Jbabdi et al., 2015].

However, limitations in dMRI and tractography can lead to biased measurements and conclusions [Jones, 2008; Descoteaux et al., 2009; Yo et al., 2009; Jones and Cercignani, 2010; Jbabdi and Johansen-Berg, 2011; Tournier et al., 2011; Jones et al., 2013]. Compared to standard anatomical MRI image, dMRI has an intrinsically low signal-to-noise ratio and low spatial resolution [Tournier et al., 2011]. Partial volume effect (PVE),

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