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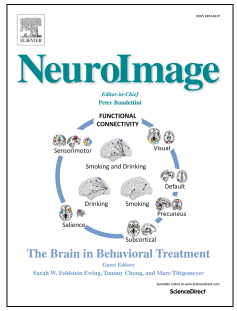

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Cortical Fibers Orientation Mapping using in-vivo Whole Brain 7 Tesla Diffusion MRI

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Abstract

Diffusion MRI of the cortical gray matter is challenging because the micro-environment probed by water molecules is much more complex than within the white matter. High spatial and angular resolutions are therefore necessary to uncover anisotropic diffusion patterns and laminar structures, which provide complementary (e.g. to anatomical and functional MRI) microstructural information about the cortex architectonic. Several *ex-vivo* and *in-vivo* MRI studies have recently addressed this question, however predominantly with an emphasis on specific cortical areas. There is currently no *whole brain in-vivo* data leveraging multi-shell diffusion MRI acquisition at high spatial resolution, and depth dependent analysis, to characterize the complex organization of cortical fibers. Here, we present unique *in-vivo* human 7T diffusion MRI data, and a dedicated cortical depth dependent analysis pipeline. We leverage the high spatial (1.05mm isotropic) and angular (198 diffusion gradient directions) resolution of this whole brain dataset to improve cortical fiber orientations mapping, and study neurites (axons and/or dendrites) trajectories across cortical depths. Tangential fibers in superficial cortical depths and crossing fiber configurations in deep cortical depths are identified. Fibers gradually inserting into the gyral walls are visualized, which contributes to mitigating the gyral bias effect. Quantitative radiality maps and histograms in individual subjects and cortex-based aligned datasets further support our results.

Keywords: diffusion MRI, 7 Tesla, high resolution, cortex, depth dependent analysis, gyral bias.