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Can we detect the effect of spines and leaflets on the diffusion of brain intracellular metabolites?

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ABSTRACT

Prior models used to clarify which aspects of tissue microstructure mostly affect intracellular diffusion and corresponding diffusion-weighted magnetic resonance (DW-MR) signal have focused on relatively simple geometrical descriptions of the cellular microenvironment (spheres, randomly oriented cylinders, etc...), neglecting finer morphological details which may have an important role. Some types of neurons present high density of spines; and astrocytes and macroglial cells processes present leaflets, which may all impact the diffusion process. Here, we use Monte-Carlo simulations of many particles diffusing in cylindrical compartments with secondary structures mimicking spines and leaflets of neuronal and glial cell fibers, to investigate to what extent the diffusion-weighted signal of intracellular

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