Development of computationally efficient strategies for deconvolution of diffusion weighted MRI data

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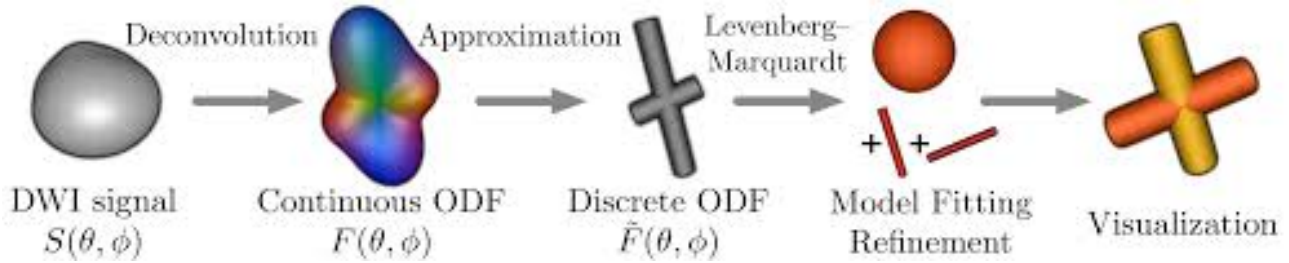
The tissue microstructure can be quantified using diffusion weighted (DW) magnetic resonance imaging (MRI). This process involves applying advanced signal processing techniques to obtain the fiber tracking in the tissue, which in turn reveals the microstructure. A key requirement for fibre tracking is the accurate estimation of three-dimensional white matter fibre orientations within each imaging voxel. The Spherical deconvolution (SD) method assumes that the fibre orientation density function (ODF) within a voxel can be obtained by deconvolving a 'reference' single fibre response function from the observed set of DW signals. In real-time (patient data), this reference response function is not known a priori and thus an estimated fibre response must be used. Here the establishment of this single-fibre response function is referred to as 'calibration'.



Typical Deconvolution Steps (taken from Schultz et. al, Ref. [2])

This project involves developing efficient computational approaches for the model fitting, including established spherical deconvolution method.

References:

[1]. Tournier JD, Calamante F, Gadian D, Connelly A. Direct estimation of the fiber orientation density function from diffusion-weighted MRI data using spherical deconvolution. NeuroImage. 2004;23:1176–1185.

[2]. Schultz T, Westin C-F, Kindlmann G. Multi-diffusion-tensor fitting via spherical deconvolution: a unifying framework. In: Jiang T, Navab N, Pluim JPW, Viergever MA, editors. MICCAI 2010, Part I. LNCS. Vol. 6361. Springer; Heidelberg: 2010. pp. 674–681.