16:10-17:00, Dec. 12th, 2015
Session (6)

Fiber orientation distribution function estimation by spherical needlets

Jie Peng

University of California, Davis

Abstract

Diffusion magnetic resonance imaging (D-MRI) is an imaging technology which uses water diffusion as a proxy to probe the anatomy of biological tissues in an in-vivo and non-invasive way. D-MRI has been widely used to reconstruct white matter fiber tracts and to provide information on structure connectivity of the brain.

In D-MRI, fiber orientation distribution (FOD) function is a spherical p.d.f. that characterizes the fiber distribution at each voxel of the brain white matter. The observed diffusion weighted measurements at the corresponding voxel can be modeled as spherical convolution between FOD and a response function. We will discuss the estimation of FOD based on a spherical needlets representation. The needlets are localized both in frequency and space and form a tight frame on the space of square integrable spherical functions. Needlets representation of FOD is sparse as FOD is a smooth function with a few sharp peaks (each corresponding to a major fiber bundle). We will derive the needlets representation of FOD by an l1 penalized regression with non-negativity constraints. Comparing with existing methods based on spherical harmonics representation, the proposed method leads to much better peak localization, particularly when the separation angles among fiber bundles are small.

(Joint work with Hao Yan from UC Davis)