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White Mater Fiber Shape and Brain Network Analysis using Diffusion Tensor Imaging

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Diffusion tensor imaging offers a unique opportunity to characterize the trajectories of white matter fiber bundles noninvasively in the brain. Whole brain tractography studies routinely generate up to half million tracts per brain. The main computational challenge is to develop a unified and compact mathematical representation of large number of tracts. We have developed the cosine series representation (CSR) to parameterize, register and perform inference in a unified Hilbert space framework. CSR can be fairly useful in shape characterization of tracts but it cannot answer more complex hypothesis about brain connectivity. To address the brain connectivity problem, we built a scalable 3D graph network model and inference was performed in the ensemble of graphs for testing for over- and under-connectivity of the brain network. Computational issues and methods are illustrated with autism case studies.