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DISCUSSION OF "FIBER DIRECTION ESTIMATION IN DIFFUSION MRI"

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Wong, Lee, Paul, Peng and ADNI (hereafter "Wong et al.") propose a threefold procedure—Diffusion Direction Smoothing and Tracking (DiST)—for the analysis of diffusion magnetic resonance imaging (dMRI) data. In the first step, they estimate multiple directions within a single voxel; in the second step, the estimation is sharpened by incorporating information from neighboring voxels in a smoothing operation; finally, in the third step, they reconstruct the fiber map using a fiber tracking algorithm.

A main contribution of the DiST procedure is the estimation of multiple directions within a single voxel. As Wong et al. rightly note, this poses challenges to existing methods due to problems of identifiability. Without the imposition of additional penalties or assumptions, or without the use of alternative acquisition schemes, it is generally not possible to resolve the data to the level of multiple fibers (crossing pathways) within a voxel. Wong et al. thus devise a computationally feasible and identifiable parameterization. This seems like a worthwhile addition to the literature on diffusion estimation and tracking.

I will confine the rest of my comments to the real data analysis, which raises some interesting possibilities for additional exploration and visualization. Table 1 of the paper shows the distribution of the estimated numbers of diffusion directions. Most voxels have one or two directions, and a few have as many as three. An obvious additional classification within these would show the directions themselves; especially for the voxels with multiple identified paths, it would be informative to know if there are dominant directions. But a classification of the directions for the voxels with just a single path might also prove enlightening. The results of these supplementary analyses might lead to additional insight: what would it mean (scientifically? functionally?) to have a dominant direction when there are multiple directions within voxels? What would it mean if there weren't such a direction? Do these differences correlate with subject covariates or task performance? These questions might be particularly pertinent for those voxels with two (as opposed to three, due to their relative scarcity) diffusion directions.

For the subject data that Wong et al. present, the reconstructed fiber tracts from the two methods are visually quite similar; familiarity with brain architecture and structure are no doubt helpful in interpreting the results, but a more objective or

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