AbstractID: 5132 Title: Demonstration of the Use of A Capillary Phantom to Monitor DTI Image Processing: Dyadic Sorting of Tensor Eigenvalues

Purpose:
To verify the existence of noise-dependent systematic bias in diffusion tensor imaging (DTI) data using a phantom composed of arrays of glass capillary fibers; and to use the phantom to monitor the corrective effect of using dyadic sorting for alleviating this bias when calculating average quantities in a region of interest (ROI).

Method and Materials:
A phantom containing glass capillary arrays and undoped water was constructed. Seventeen DTI series of images from a 3.0T GE scanner were acquired, where TR was adjusted between series to vary the signal intensity via T1 contrast. Five different values of TR were chosen. Averaging of some of these series together allowed for observations at eight unique values of SNR. Eigenvalues and eigenvectors of the diffusion tensor were calculated as well as fractional anisotropy. After calculation of the average eigenvalues and eigenvectors in ROIs containing the arrays and free water, these average values were used to sort eigenvector-eigenvalue dyadic pairs to maximize overlap between the average values and individual voxel values. Final averages were calculated after sorting.

Results:
Noise-dependent bias was observed using arrays of fibers, resulting in a separation of the two lowest eigenvalues which should be equivalent. Dyadic sorting assists with correcting this bias, although usefulness is confined to regions of lower FA and with higher SNR. Iterative sorting does not greatly improve the performance.

Conclusion:
This work suggests that glass capillary arrays can be used for monitoring systematic bias at a variety of SNR values, and for quantifying the amount of correction that one will observe using a particular scheme, in principle. Future investigation will examine the efficacy of other correction schemes.

Conflict of Interest (only if applicable):