

AbstractID: 13245 Title: Correlation between MR Diffusion Tensor Imaging Derived Dimensional Ellipsoid Ratio as a Function of Tissue Anisotropy and Multiple Sclerosis Induced Variation

**Purpose:** The diffusion fractional ellipsoids derived in ratios  $(X_{MS} - X_{NC})/X_{NC}$  are compared from both the Monte Carlo simulation and the deviated diffusion profile between normal brains and Secondary Progressive Multiple Sclerosis (SPMS) patients. We construct a map to evaluate the water diffusion in (1) standard sorted, (2) non-sorted, and (3) normalized space of directional diffusivity and diffusion anisotropy indices.

**Method and Materials:** The sensitivity coefficients are derived analytically between the anisotropy indices and diffusivities in the symmetric, prolate  $\lambda_1 > \lambda_2 = \lambda_3$  and oblate  $\lambda_1 < \lambda_2 = \lambda_3$  diffusion, and non-symmetric geometry. The contrast-to-scatter ratios are calculated from the Monte Carlo simulation conducted in Matlab (MathWorks, Natick, MA) in addition to the mean contrast comparison of diffusion tensor derived parameter from white and gray matter of a SPMS study acquired in GE Signa 1.5T scanner with 21 gradient weighted direction scheme, TR/TE=10800/80ms, FOV=24cm, voxel size= 1x1x3 mm<sup>3</sup>, matrix size = 128x128, and b = 1000 s mm<sup>-2</sup>. Statistical comparison was performed in SPSS (SPSS Inc, Chicago, Illinois) to determine the significant Pearson correlation and difference of both within and across diseased and normal fiber bundles.

**Results:** The sensitivity of the diffusion anisotropy indices as expressing from a ratio of standard deviation to magnitude/average is higher than the diffusivities in low anisotropy region. The diffusion ellipsoid of low anisotropy tissue is observed to be prolonged as SNR<20. The contrast-to-scatter ratio of FA decreases slightly with increasing anisotropy for SNR>20.

**Conclusion:** Sensitivity analysis is demonstrated as a standard to derive the dimensional ellipsoid ratio as a function of anisotropy level and tissue type. A multiple sclerosis induced oblate ratio ellipsoid was observed in both of the genu and splenium corpus callosum, while prolate ratio was found in the internal capsule and thalamus. In contrast, both the radial and axial diffusivity decrease in the caudate nucleus.