AbstractID: 7267 Title: Automated Classification of Substructures of White Matter Via Anisotropic Water Diffusion

Purpose: Diffusion tenor imaging (DTI) has been shown to be a valuable technology for *in vivo* assessment of white matter (WM) diseases, and has potential for monitoring the effect of radiation on WM structures. The aim of this work is to develop an automated method for classification of substructures of normal-appearing and disease-affected white matter (NA and DAWM) from diffusion tenor images. Methods: The methodology is based upon the fuzzy c-means clustering algorithm with nearest-neighbor spatial constraint to enhance spatial continuity and overcome intensity inhomogeneity. To resolve substructures of WM and grey matter (GM), which are obscured by large diffusion coefficients and variations in cerebral-spinal fluid (CSF), a two-layer hierarchical tree of fuzzy classification was developed. In the first level of classification, tissue is segmented from CSF or a fluid-like class. Then, tissue is further partitioned into subclasses based upon their characteristic anisotropic water diffusion. We tested which feature space could result in better classification, in which the DTI data were presented as diffusion-weighted data, elements of the diffusion tenor, and eigen-diffusivities. We applied the method to DTI data from patients with normal-appearing WM, low grade glioma, meningioma, and benign brain tumors. Resolved structures of NAWM and GM were compared to a brain atlas. Results: Eigen-diffusivities resulted in most robust classification of substructures than other forms of data. Resolved substructures included genu and splenium of corpus callosum, corticospinalfibers, subinsular WM, optical radiation WM, internal capsule, caudate nucleus, lenticular nucleus, and thalamus. Necrotic tumor and edema regions of WM were identified with either a fluid-like or sub-tissue class, depending upon the water content, and viable tissue. Conclusion: We have developed a robust method for classification of substructures of NA and DA WM and GM using DTI. The differentiated substructures could be useful for radiation treatment planning, and for monitoring radiation effect.