Abstract ID: 16357 Title: Delineation of Functional Thalamic Subregions: A Comparison of Probabilistic Diffusion Tractography and Electrophysiology

Purpose: To delineate functional subregions of the thalamus through probabilistic diffusion tractography and electrophysiology.

Methods: We acquired diffusion weighted MRI scans in a set of five thalamic deep brain stimulation (DBS) subjects in order to employ probabilistic diffusion tractography (PDT) for localization of connections from the thalamus to somatosensory cortex (S1) and primary motor cortex (M1)/supplementary motor area (SMA). We defined and implemented a novel model to delineate PDT based thalamic functional subregions, i.e. connectivity defined regions (CDR). In this "mixture" model, a voxel can be considered to be comprised of multiple functional circuits. This model is compared against the "separation" model whereby a voxel is functionally associated with the dominate circuit that inhabits that voxel. The ability for these models to correctly classify a voxel as corresponding to sensory or motor was determined by comparison against a "gold standard" (ie. electrophysiology).

Results: In the separation model, both sensory and motor responsive cells (from electrophysiology) were found to lie within the motor CDR (with the exception of one sensory responsive cell). Separation model defined CDRs grossly overestimated the extent of the motor CDR and further underestimated the extent of the sensory CDR. A threshold (between 1% and 8% of the total number of fibers in a voxel) was used to create a mixture model sensory CDR that spatially maximizes inclusion of sensory cells and minimizes inclusion of motor cells. A mixture model motor CDR at similar thresholds spatially included all motor cells but also included all sensory cells suggesting that motor circuits strongly innervate areas with sensory cells but that the reverse is not necessarily true.

Conclusions: Mixture model delineation of CDR offer a significant improvement in delineation of functional subregions (as compared with electrophysiology). The data from this study suggests that tractography derived data may correlate with electrophysiology.