# Optimal Acquisition and Processing Strategies for Accurate and Precise Neurite Orientation Dispersion and Density Imaging (NODDI) Modeling of the Spinal Cord

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Diffusion Magnetic Resonance Imaging (MRI) has been used to model tissue microstructure non-invasively. One such model called Neurite Orientation Dispersion and Density Imaging (NODDI), has proven helpful in brain imaging and the study of Alzheimer's Disease. The NODDI model has not been applied to spinal cord MRI data due to challenges associated with its size and location. However, identifying spinal cord microstructure features such as neurite orientation and dispersion would aid in understanding and diagnosing spinal cord diseases such as multiple sclerosis, as prior research indicates. An accurate MRI acquisition requires at least two B-value settings, which sensitizes the MRI machine to the diffusion of water. My research aimed to determine optimal acquisition for NODDI modeling by discerning which combination of two B-values yielded the highest similarity of biophysical parameters to the fully sampled acquisition and highest signal-to-noise ratio (SNR). I obtained data of a single unidentifiable healthy volunteer which was preprocessed from the Spinal Cord Toolbox in MATLAB. Forty imaging protocols in one scanning session were performed at each of the following B-values: 700, 1400, 2100, 2800, 3500, 4200. Seven imaging protocols using a B-value of zero served as a control. Through MATLAB scripts, subsamples of the acquisition were grouped according to 15 different combinations of two varying B-values in a subsample. Each subset generated a large combinatorial number of NODDI maps. With the use of binary masks, the subset yielding the highest SNR in Python and similarity of biophysical parameters to the fully sampled acquisition in MATLAB determined the most appropriate grouping of B-values. The optimal subsample contained B-values 1400 and 4200.