EVALUATION OF DTI IMAGE ANALYSIS USING NONLINEAR SPATIAL NORMALIZATION AND TISSUE-SPECIFIC, SMOOTHING-COMPENSATED VOXEL BASED ANALYSIS: APPLICATION IN AUTISM

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Introduction: Analysis of DTI data using voxel-based analysis (VBA) is attractive because it can evaluate all regions of the brain without prior hypotheses about specific regions-of-interest or tedious region-drawing by hand. However, limitations of VBA include misregistration, blurring, and limited statistical power from multiple comparisons. A minor adaptation of VBA called tissue-specific, smoothing-compensated (T-SPOON) VBA [Lee et al. 2007a] addresses several of these issues. Partial volume effects are reduced by segmenting specific tissue regions. Smoothing errors are further reduced by T-SPOON processing. In the current study a nonlinear warping registration algorithm, ART (autormated registration toolbox) is used, which is more accurate for between-subject image registration than affine methods [Ardekani et al. 2005]. The effects of T-SPOON VBA combined with ART are evaluated.

Methods: DTI data were acquired on 43 subjects with high-functioning autism and 34 controls matched for age and IQ [details in Alexander et al. 2007]. Maps of FA and mean diffusivity (MD) were computed. White matter (WM) masks were segmented. DTI maps and WM masks of each subject were spatially normalized to an FA brain template using ART [Ardekani et al. 2005]. An 8mm Gaussian kernel was applied. Blurring effects of normalization and smoothing were compensated by dividing the normalized,smoothed DTI maps by the normalized, smoothed WM mask. Group comparsons (autism versus controls) was performed using an ANCOVA (with age as a co-variate) at the $p<0.05$ level. The effects of multiple comparisons were reduced by applying a false discover rate (FDR) constraint of 0.05 and a cluster extent constraint at the $p<0.05$ level as well. The results of the T-SPOON VBA were compared against conventional unsegmented (CONVEN) VBA without any T-SPOON processing.

Results: Figure 1 displays the results of the FA(control)>FA(autism) tests for both VBA methods. Results are similar although significant differences in the temporal lobe were only observed with T-SPOON (arrows), consistent with published data in these areas [Lee et al. 2007b]. Results of MD(autism)>MD(control) tests show much more diffuse regional differences. Results are similar although T-SPOON shows more significant differences in the corpus callosum consistent with Alexander et al. [2007]

Conclusions: Compared to studies using affine spatial normalization [Lee et al. 2007a], the effects of T-SPOON with ART appear to be smaller, yet significant. With both co-registration methods, results using T-SPOON show better correspondence to previously published results [Alexander et al. 2007; Lee et al. 2007b].

References: Alexander AL et al. Neuroimage 34:61-73;2007.
Ardekani BA et al. J. Neurosci Methods 142:67; 2005
Lee JE et al. ISMRM abstract 1465;2007a
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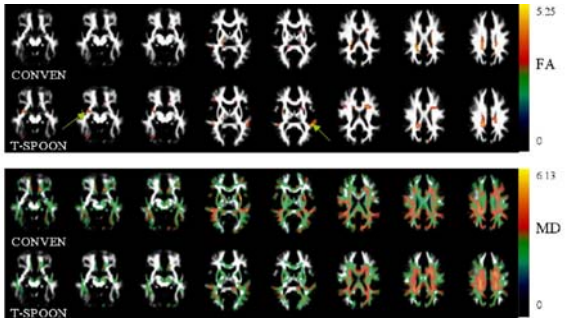

Category: Modeling and Analysis
Sub-Category: Motion correction/Spatial normalization, atlas construction