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DEEP SUPER-RESOLUTION IMPROVES ASYMMETRY MEASUREMENTS FROM DIFFUSION TENSOR IMAGING IN PARKINSON'S DISEASE

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Aims: Motor symptom laterality early in Parkinson's disease (PD) suggests that asymmetry in brain measurements may be an important marker of disease [1]. Deep super-resolution (DSR) techniques in diffusion-weighted magnetic resonance imaging (DWMRI) can improve anatomical detail and, consequently, detection of Parkinson's disease (PD) related asymmetries in white matter that may be uniquely informative. We demonstrate preliminary results showing that DSR enhances asymmetry measures derived from DWMRI by improving test-retest reliability and detection of population effects in a PD cohort.

Methods: We processed DWMRI from the Parkinson's Progression Markers Initiative (PPMI). All DWMRI underwent the identical ANTsPyMM pipeline for both native and perceptual super-resolution (doubling resolution). The cohort included 243 subjects with consensus diagnoses of n=104 controls and n=139 sporadic PD with at least one followup image. We summarized asymmetry in fractional anisotropy (FA) and mean diffusivity (MD) using regions defined by the John Hopkins University white matter atlas.

Results: Reliability for asymmetry measurements overall was assessed by intraclass correlation (ICC): SR = 0.56, OR= 0.48, $p < 0.001$; ICC > 0.5 indicates moderate reproducibility. Cross-sectional effect sizes for diagnosis were aggregated across regions with SR showing improvement: mean SR Cohen's d = 0.25; mean OR Cohen's d = 0.14, paired t-test $p < 0.05$. Similarly, longitudinal effect sizes for significant changes in asymmetry related to diagnosis groups were also aggregated: mean SR Cohen's d = 0.19, mean OR Cohen's d = 0.13, paired t-test $p < 0.05$.
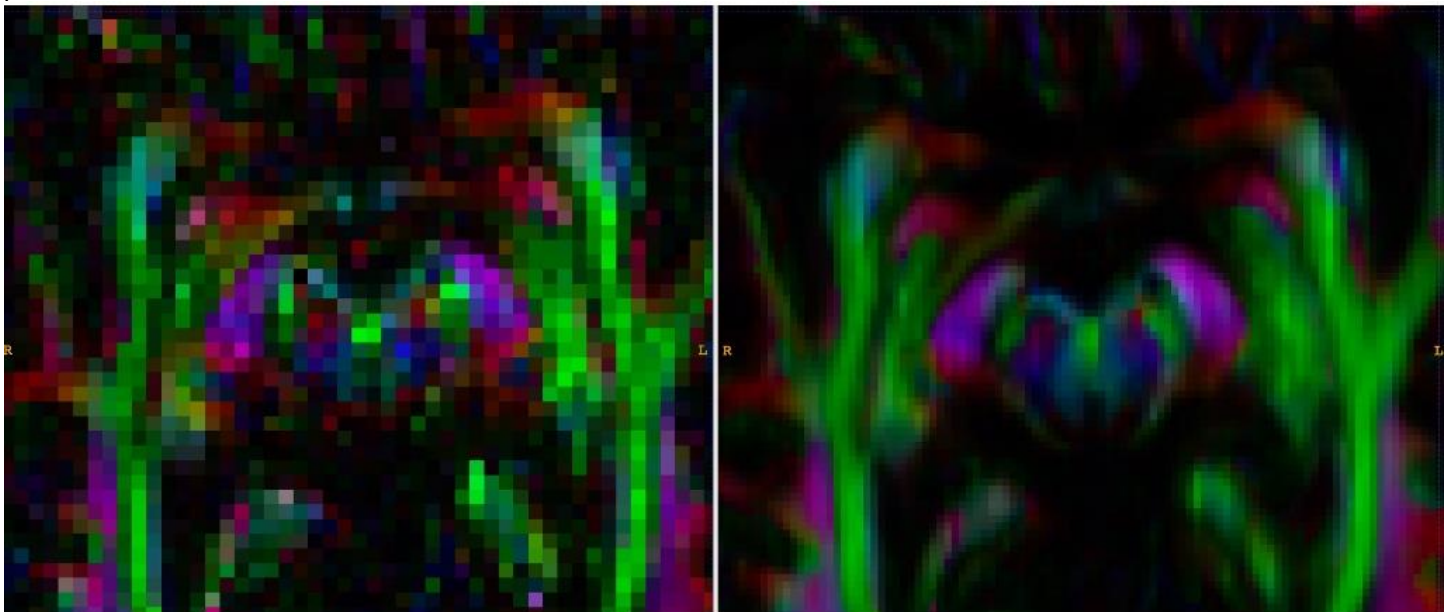
PD subject SN original resolution   Same PD subject SN super resolution

Conclusions: Deep SR improves asymmetry metrics in PD in both cross-sectional and longitudinal designs. The value of DSR is highlighted particularly in longitudinal studies of asymmetry which involves measuring the change of a difference. Future work will investigate the value of such measures in earlier stage PD or prodromal subjects. [1] 10.1002/hbm.25558