Diffusion tensor imaging of the mouse brain with a cryogenic coil at ultrahigh-field: fast imaging allows for cohort studies

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Introduction: *In-vivo* high resolution diffusion tensor imaging (DTI) of the mouse brain is often limited by the low signal to noise ratio (SNR) resulting from the required small voxel sizes. Recently, cryogenically cooled resonators (CCR) have demonstrated significant increase of the effective SNR.

It is the objective of this study to enable fast DTI of the mouse brain. In this context, CCRs appear attractive for SNR improvement [1].

Methods and Materials: Three mice underwent a DTI examination at 156² x 250 µm³ spatial resolution with a CCR at ultrahigh field (11.7T). Diffusion images were acquired along 30 gradient directions plus 5 references without diffusion encoding, resulting in a total acquisition time of 35 minutes. For comparison, mice additionally underwent a standardized 110 minutes acquisition protocol published earlier [2]. Fractional anisotropy (FA) and fiber tracking (FT) results including quantitative tractwise fractional anisotropy statistics (TFAS – [3]) were qualitatively and quantitatively compared.

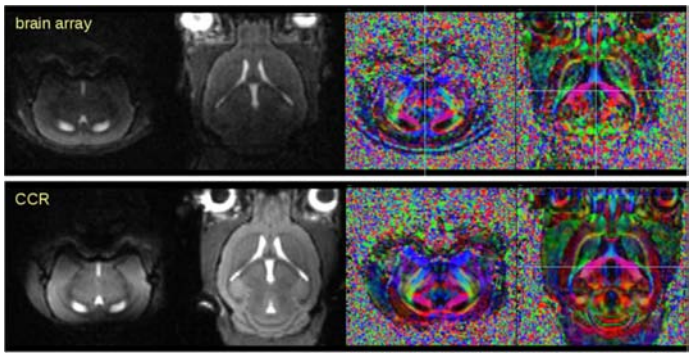

Figure 1: *brain array coil (**upper panel**) vs. cryogenic cooled resonator (CCR – **lower panel**). **Right:** (b=0) anatomical images used for signal-to-noise ratio (SNR) estimation. **Left:** Directional encoded color maps of FA.*

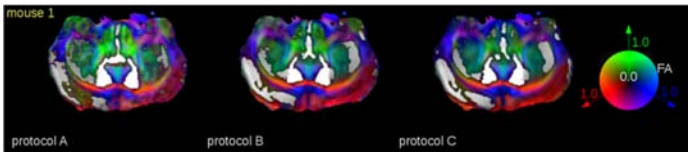

Figure 2: *Directional encoded color maps of FA overlaid into (b=0) anatomical images: comparison of FA quality for scanning protocols (SPs) A (35 minutes, 1 average), B (110 minutes, 6 averages), and C (18 minutes, 1 average). FA-display threshold was 0.2.*

Results: Figure 1 shows the comparison of a CCR with a brain array coil. Qualitative and quantitative assessment of the calculated fractional anisotropy maps and fibre tracking results (Figure 3) showed coinciding outcome comparing 35 minute scans to the standardized 110 minute scan (Figures 2). Coefficients of variation for ROI-based FA-comparison as well as for TFAS revealed comparable results for the different scanning protocols.

Discussion: Mouse DTI at 11.7 T was performed with an acquisition time of approximately 30 minutes which is considered feasible for cohort studies. The rapid acquisition protocol reveals reliable and reproducible FA-values and FT reconstructions, thus allowing an experimental setup for in-vivo large scale whole brain murine DTI cohort studies.

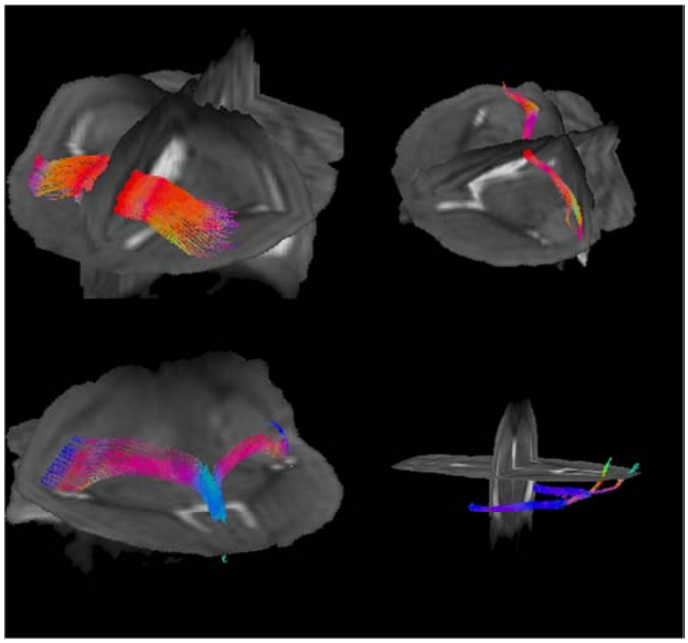

Figure 3: *FT results for seed points in the genu and along the corpus callosum, near the lateral septal nucleus, the splenium, and in the olfactory path. display background. was (b=0)-scan.*

References:

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