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(G*) Pulse Sequence Considerations for Accelerated Low Field MRI

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Introduction: We have recently demonstrated¹ a compressed-sensing (CS)-based undersampling method capable of improving signal-to-noise ratio and image quality of low field images. An optimal choice of pulse sequence would reduce undersampling artefacts and improve image quality; in this work, different sampling patterns in k -space for the X-Centric² and Sectoral^{3,4} sequences are investigated at high acceleration factors (AF = 7, 10, 14).

Method: The X-Centric sequence acquires each half of k -space separately, in the readout direction, reducing signal loss from diffusion and relaxation. Both halves normally acquire the same phase-encode lines in k -space (non-alternating), but they can also sample a unique set of lines (alternating). The Sectoral sequence splits a circular area of k -space into sectors (here, 64), and acquires each sector from the centre-out, oversampling the contrast-rich centre. The proposed sampling pattern consists of stopping each sector prematurely, ensuring the undersampling is confined to the edges of k -space.

In-vitro ¹H MRI was performed at 73.5mT. Seven sets of 9 images each were acquired with X-Centric: one set per AF for each sampling pattern, and one fully-sampled set to be retrospectively undersampled using the proposed Sectoral sampling. The Fourier-transformed (FT) images were compared to the CS-based reconstructions using the structural similarity index (SSI); all images were 128px², FOV=8cm².

Results: The FT images acquired using X-Centric had SSI scores around 35%; however, the FT Sectoral images had a SSI score of 96% and virtually no artefacting, with only slight blurring. The CS reconstructions of all 3 sampling patterns had SSI scores around 87%, with Sectoral exhibiting fewer artefacts.

Conclusion: Although the CS reconstructions of all 3 proposed sampling patterns had similar SSI scores and artefacting, in line with our previous work, the direct FT images of Sectoral were free of artefacts, comparable to the fully-sampled images, even at AF=14 (only 7% of k -space): the artefacts in the CS image are likely due to over-fitting the reconstruction parameters. These results suggest that the proposed Sectoral sampling pattern is well suited for accelerated low field MRI.

References:

1 Perron, S. et al. ISMRM (2022); 2 Ouriadov, A.V. et al. MRM. (2017); 3 Khrapitchev, A. A., et al. JMR (2006); 4 Perron, S. et al. JMR (2022).

Keyword-1

MRI

Keyword-2

Pulse Sequence

Keyword-3

Undersampling

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