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Contribution ID: **3379** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Novel Accelerated Imaging Method for 1H and 129Xe MRI with Deep Learning

Monday, 6 June 2022 11:30 (15 minutes)

Introduction: Recently, accelerated imaging, using Compressed-Sensing (CS) and fitting to the Stretched-Exponential Model (SEM), has been shown to significantly improve SNR of MRI images without increasing scan duration¹: k-space is undersampled according to high acceleration factors (AF) and averaged together using a specific averaging pattern. A density decay curve can then be fitted and reconstructed using the SEM combined with CS.² Reconstruction artefacts can be minimized or removed using a convolutional neural network.³

Method: ¹H MR was performed on a resolution-phantom at the low-field (0.074T) MRI scanner using a home-built RF coil. Using FGRE, 9 2D undersampled k-spaces were acquired for three AFs (7, 10, 14): these were averaged for every unique combination of images without overlap, resulting in 14 k-spaces total (2 combinations for 4 averages, etc.). Nine fully-sampled 2D human lung images were acquired at 3.0 T using inhaled hyperpolarized ¹²⁹Xe (35%); these were averaged using the previously-described pattern, and retroactively undersampled for 3 Cartesian sampling schemes (FGRE, x-Centric⁴, & 8-sector FE Sectoral⁵). The SNR attenuation is assumed to represent a decrease of the resonant isotope density in phantom after diluting it with the non-resonant isotope. For both phantom and lung images, the resulting signal decay (density) curve was fitted using the Abascal method.² A 3-stage U-Net was developed to generate artefact masks (segmentation), and applied to phantom data to remove artefacts.

Results: The reconstructed human lung images saw 4-5x higher SNR (>21 for all sampling schemes) compared to the original non-averaged images (SNR=6). FE-Sectoral featured less artefacts than FGRE and x-Centric.

Conclusion: In all cases, this technique resulted in 4-5x higher SNR without increasing scan duration; although only a third of a typical ¹²⁹Xe dose was used, the human lung images still saw large SNR gains. The artefact removal neural network was able to remove reconstruction artefacts from AF=7 phantom images, but suffered at higher AFs. These improvements in SNR permit the use of a smaller xenon dose, significantly reducing scan costs.

References:
1 Perron et al. ISMRM (2021); **2** Abascal et al. IEEE Trans Med Imaging (2018); **3** Lee et al. MRM (2017); **4** Ouriadov et al. MRM (2017); **5** Khrapitchev et al. JMR (2006)

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