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(G*) The Use of a Novel Sampling/Reconstruction Method for Non-Proton and Low Field MRI

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<p>**Introduction:** MRI's low sensitivity, caused by the use of nuclei with low-gyromagnetic ratios or low magnetic field strength, can presently be improved with expensive high-field MRI-hardware and/or expensive enriched-isotopes. We propose a new method that does not require any extra signal-averaging or hardware to improve the quality of MRI images. We will use a significant k-space under-sampling acquisition method where only a certain percentage of the k-space points will be acquired per image, corresponding to the acceleration-factor (AF); it follows that one can acquire ten under-sampled images in the same time as one fully-sampled image. Averaging each possible combination of images of the under-sampled set, a density decay curve can then be fitted and reconstructed using the Stretched-Exponential-Model (SEM) combined with Compressed Sensing (CS).¹</p>

<p>**Method:** ¹H MR was performed on a resolution-phantom at the low-field (0.074T) MRI scanner using a home-built RF coil. Nine 2D fully-sampled k-spaces were acquired. Combinations of 2, 3, and 4 averages were carried out for each possible permutation, resulting in 14 k-spaces total (2 combinations for 4 averages, etc.); these were retroactively under-sampled for three AF's (7, 10, 14). 3 Cartesian sampling schemes (FGRE, x-Centric², 8-sector FE Sectoral³) were used. The SNR attenuation is assumed to represent a decrease of the resonant isotope density in phantom after diluting it with the non-resonant isotope. The resulting signal decay (density) curve was fitted using the Abascal method.¹</p>

<p>**Results:** The SNR of the 9 k-space averaged image and the original image was 16 and 5, respectively. The SNR of the three sampling schemes is 15 for FGRE, 19 for x-Centric, and 17 for FE Sectoral.</p>

<p>**Conclusion:** The improved SNR of the generated images for all sampling schemes demonstrate that the SEM equation can be adapted for fitting the SNR decay dependence of the MR signal. Since this technique does not require extra hardware, the proposed method could be implemented in current MRI-systems and yield improved images. Due to the CS-based reconstruction, the higher AF leads to more visible artefacting; this could be reduced by a Deep Learning-based correction after the fact.⁴</p>

<p>**References:** **1** Abascal et al. IEEE Trans Med Imaging (2018); **2** Ouriadov et al. MRM (2017); **3** Khrapitchev et al. JMR (2006); **4** Duan et al. MRM (2019)</p>

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