

Accelerated imaging with constrained reconstruction and undersampled radial acquisition: Applications to hyperpolarized helium-3 MRI

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Hyperpolarized helium-3 (HP He3) provides a unique contrast agent for imaging the airspaces of the lungs with high contrast to noise. However the signal decays back to thermal polarization levels at a rate determined by T_1 and is also partially consumed without recovery by each applied RF excitation. The short breath hold times required to accommodate patients with compromised lung function (<20 s) imposes additional time constraints on the technique. Because of these limitations, accelerated imaging techniques can provide a tremendous advantage over existing methods and may enable applications that are otherwise impossible. The combination of constrained reconstruction techniques such as HYPR and I-HYPR with undersampled radial acquisition enables reconstruction of more images per repetition time. This has the effect of reducing both scan time and the number of RF pulses that must be applied, saving magnetization. This technique is applied to HP He-3 q-space imaging of the lung and rapid dynamic imaging of ventilation.