Abstract #85 | Poster

Improving the image resolution of single breath hold dissolved phase ^{129}Xe images

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Introduction

Hyperpolarized ^{129}Xe gas as a MR contrast agent probes into key characteristics of the pulmonary physiology. The currently recommended clinical protocol advice multiple administrations to acquire information on regional ventilation and gas transfer from the alveoli to the pulmonary capillaries (1). It has been shown feasible to acquire both gas transfer and gas-distribution imaging in a single ^{129}Xe administration achieving 2-3 cm isotropic resolutions with breath-hold-time less than 20s (2, 3). The aim of this work is to demonstrate a sampling method with an improved image resolution.

Methods

A 3D radial density weighted MRSI trajectory (4) with an isotropic resolution of 2cm^3, matrix size of 14x14x7 and a FOV = 28x28x14cm requiring a total of 1799 excitations was compared to a 3D Cartesian MRSI trajectory designed with a resolution of 1x1x2cm^3, matrix size of 28x28x6 and a FOV = 28x28x12cm requiring a total of 2416 excitations. Fig. 1 illustrates the two sampling trajectories. With a repetition time of 7.4ms, this results in a total acquisition duration of 14s and 18s for the density-weighted and Cartesian trajectories, respectively. Acquired data was zero-filled spatially with a factor of 2 and spectrally to 256 samples. Spectral bandwidth was 20kHz.

MRI was performed on a 40 kg pig with 1L of enriched ^{129}Xe (5) on a 3T GE MRI scanner with a ^{129}Xe transmit-receive vest coil.

Results/Discussion

Results indicates the feasibility of improved resolution dissolved phase images. This is indicated by preserved spectral information (Fig. 1) with little loss in signal-to-noise ratio in the central coronal gas image (6.35 and 10.96 for Cartesian and density weighted, respectively). The improved image resolution is clearly seen in the dissolved phase gas, tissue, and blood images by visualization of the bronchi, more pronounced regional differences between tissue and blood and depiction of unsaturated heart blood signal (Fig. 2).

Future perspectives include undersampling schemes such as partial Fourier k-space acquisition. Undersampling will speed up the total acquisition time without significant loss of signal (hyperpolarized signal). Faster acquisition time can be traded for either further improved resolution or shorter breath hold. If traded for improved resolution a matrix size of 80x80x20 would be beneficial as it would be comparable to clinically used ventilation images.

Conclusions

Dissolved phase and gas images with improved resolution in a single breath hold is feasible with the

application of a 3D Cartesian MRSI trajectory. Results indicate great potential and possibilities for clinical application, allowing spatially sufficient simultaneous ventilation parameters and/or for patients with more severely decreased pulmonary function to be examined with ^{129}Xe lung MRI.

Acknowledgement

Disclosure

M.V. and R.F.S. are employees of GE Healthcare. The authors report no conflicts of interest.

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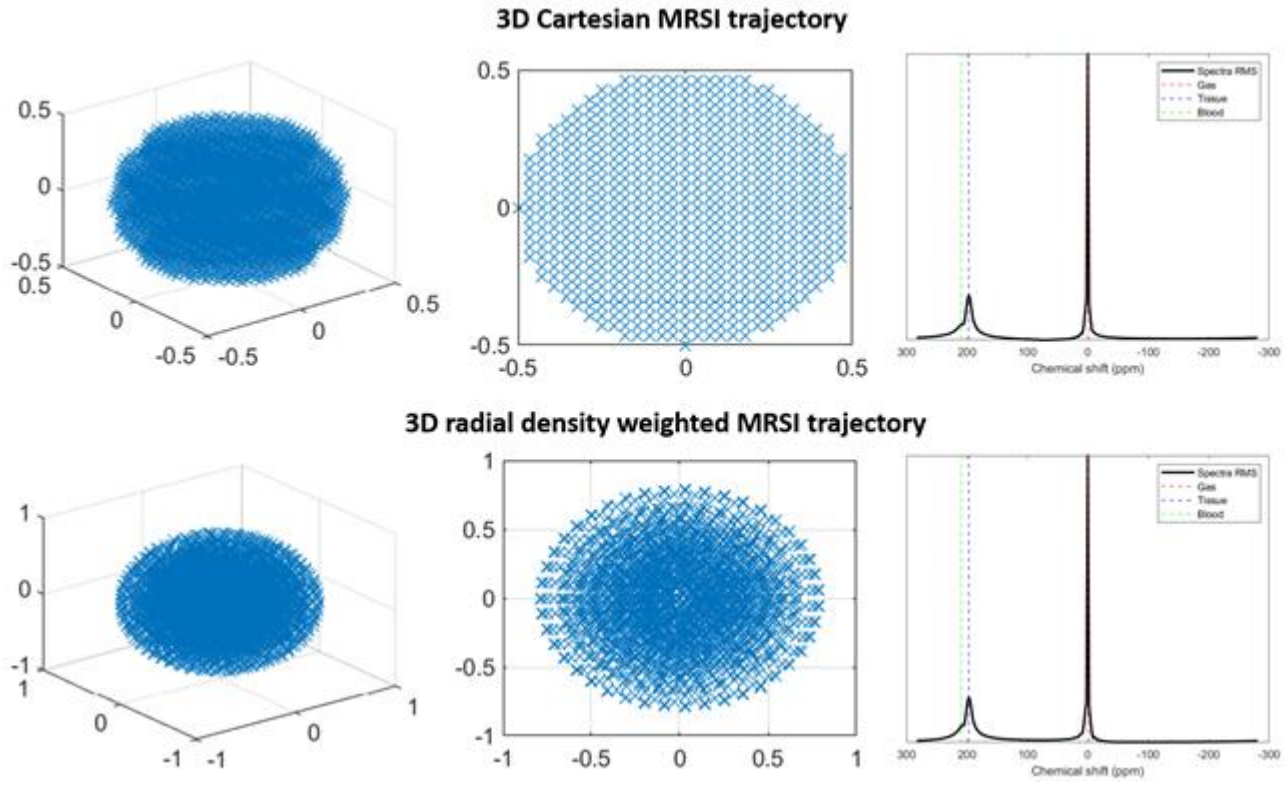

Figure 1
Illustration of the two sampling trajectories in 3D (left), at z-gradient = 0 (middle) and Summed Root Mean square (right) spectra values of the Cartesian (top) and radial density weighted (bottom) acquired data. Undersampling at higher frequencies.

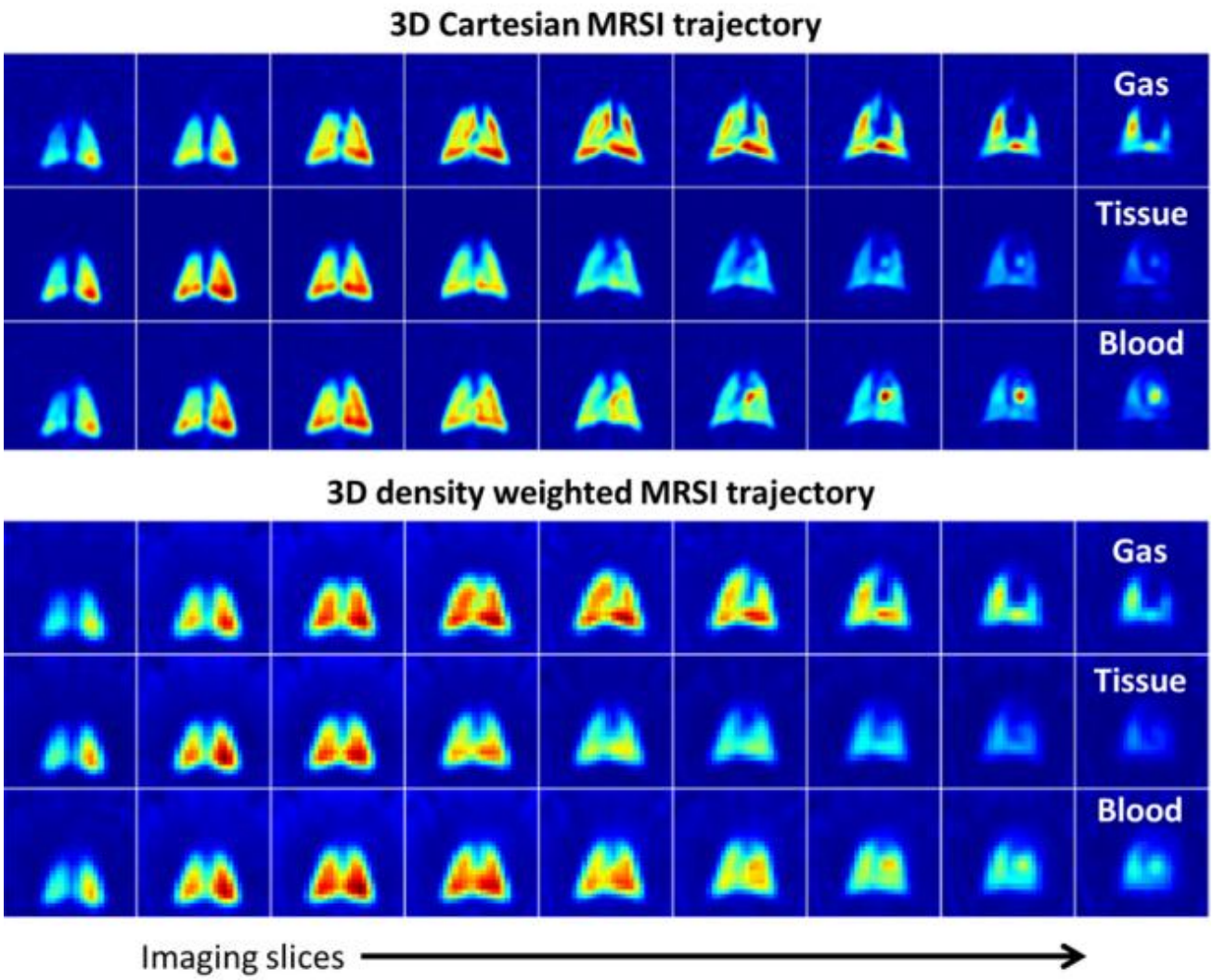

Figure 2
Dissolved phase gas, tissue, and blood images from the Cartesian (top) and density weighted (bottom) acquired data. Images show nine of the 12 (top) and 14 (bottom) slices.