High resolution whole body screening using 3D Wideband MRI

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Abstract

We have demonstrated the ability to perform high-resolution mice whole body screening using Wideband MRI technique in this study. Two sets of results display the wideband accelerated image of a whole mice with wideband acceleration factor "W" of 6 and 8. Total scan time was dramatically reduced from around 1 hr to 10 mins (W=6) and 7 mins (W=8). This serves as a pilot study for accelerated human whole body diagnosis and cancer metastasis study.

Introduction

Wideband MRI is an accelerating method that utilizes a wider bandwidth to acquire multiple images from different positions in one single repetition time. We have confirmed that wideband MRI accelerated images without incurring any degradation in image quality. From discovered properties so far it is suffice to say wideband MRI is a promising method for applications obtaining large coverage such as whole human body screening. We also claimed that at least 4 times Wideband acceleration can be achieved on a human MRI system, and even 8~10 times can be obtained depending on the VOI's geometry [2]. Such benefits are the key to whole body MRI diagnosis and cancer metastasis research. However, conventional RF coil designs and RF homogeneity of the coil are designed and optimized for limited volume in human imager and is, therefore, not appropriate to demonstrate this specific application. In this study, we choose animal imaging platform as the pilot to provide the coverage necessary for mice whole body scan with a speeding-up factors of 6-8.

Materials and methods

The scans were performed on a Bruker 7T Topspin animal system using a single channel volume coil. The volume coil is long enough to provide the homogeneous B1 for this mouse whole body screening. Imaging parameters and resolution is listed in table 1. Excitation pulse of Wideband MRI was calculated and synthesized according to the geometry of the total coverage and desired Wideband acceleration factor. The overall bandwidth was increased proportionally with the Wideband acceleration factor used.

Results

Shown below in the figure 1 are the W=6 and W=8 whole body images. Each image contains *W* slices of different locations of the mice. Figure 1(a) contains 6 slices and 1(b) contains 8 slices. From the head through chest and abdomens until bladder and hinder feet, all slices were evenly spaced in the outcome wideband image. A total 512 slices of high-resolution axial images were acquired. For the W=6 acceleration, the total scan time is significantly reduced to 10 mins from 60 min with conventional 3DMRI; for the W=8 case, it is further reduced to 7 mins for this high resolution whole body scanning, with a 176μm thickness. The bandwidth per slice still remains the same as normal 3D imaging, thus explaining the SNR consistency. . The images shown were obtained with sacrificed mice; images using in-vivo mice images may suffer from motion artifacts.

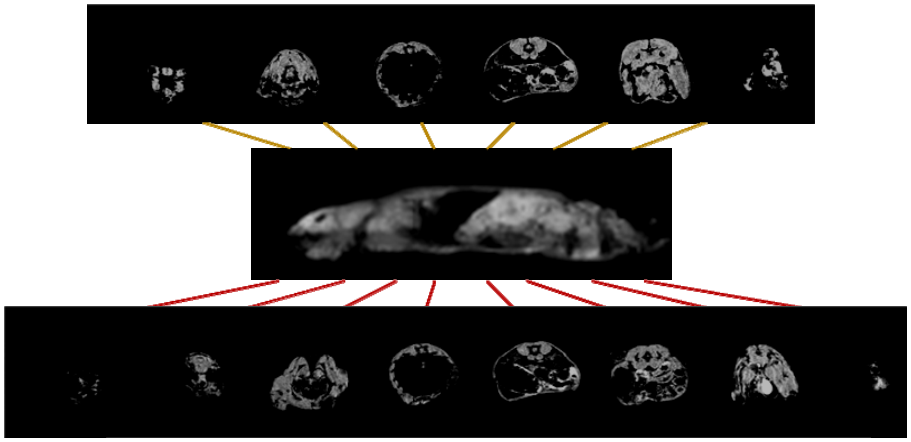

Fig.1 Wideband accelerated mice whole body images with wideband factor of W=6(above) and W=8(lower) respectively.

Wideband factor	W=6	W=8
FOV	3.5cm x 2.5cm	
Matrix size	1536*192	2048*192
Coverage	9cm	
Spatial resolution	136x130x176 (μm3)	
TR/TE	38/14 (ms)	
Single Scan time	10mins (60mins)	7mins (56mins)

Table1. Parameters of W=6 & W=8 accelerated images. Numbers in red indicate scan time without acceleration

Conclusion

High resolution whole body imaging is a desirable feature for whole body oncology MRI study. The results here show that Wideband MRI can be used for this application with 6 to 8 times acceleration. As we have pointed out in our previous results, the reduction of scan time can be pushed further with the combination of parallel imaging techniques [4]. Once the whole body scan time drops below several minutes, quantitative molecular imaging, whole body dynamic contrast enhancement and cancer metastasis study will become possible for MRI. With the ability of Wideband MRI displayed here, we believe this is likely to happen soon.

References

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