W=2 Acceleration Single carrier Wideband MRI Technique and Blur Mitigation Method

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Introduction

Wideband MRI utilizes the idea of frequency multiplexing to accelerate the scan time and is highly compatible to others sequences (fast spin echo, gradient echo etc.) and accelerate methods (parallel imaging etc.). The very same concept can either be applied to acquire image of multiple locations at the same time [1] or to simultaneously acquire different parts of one excited region, so called Single carrier Wideband acceleration. A blurring effect occurs in Single carrier Wideband MRI due to phase accumulation caused by separation gradient [2]. Therefore, the modified sequence with an added inverse gradient was used to eliminate the blurring effect. In this study we demonstrate the Single carrier Wideband technique and the blur mitigation result

Materials and Methods

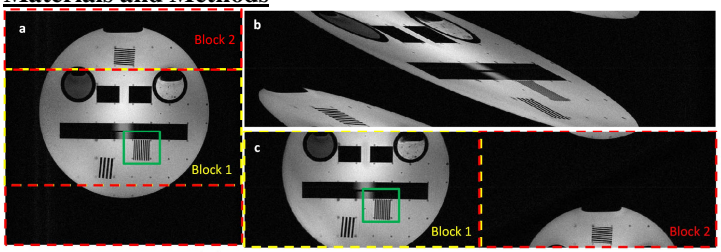

Fig 1. a) The figure illustrates how Single carrier Wideband MRI acquires different parts (blocks) of the original FOV. b) The actual image acquired by Single carrier W=2 Wideband MRI. c) the shear effect induced by separation gradient was corrected in the image.

Fig 1 shows the results of W=2, Single carrier wideband MRI. The amount of information required for a single image with same resolution was unchanged while the separation gradient conveys the time consuming phase encoding steps onto the frequency encoding process. To demonstrate the blur mitigation technique further, three scan protocols was compared, including a) standard gradient echo b) Single carrier Wideband MRI with *W*=2 acceleration and c) Single carrier Wideband MRI with W=2 acceleration and blur mitigation applied. All the imaging was taken on a 3T Bruker MRI/MRS system with quadrature head coils. The gradient echo sequence scan cover FOV 25.6 x 25.6cm, matrix size was 256 x 256, resolution 1mm^2, thickness was 4mm and TR/TE was 70ms/10ms. The scan time using Wideband MRI technique was 8s, which reduced 2 times from its original scan time. The contrast of 1mm high resolution structure was used to exam the blurring effect (green box in Fig 1).

Results

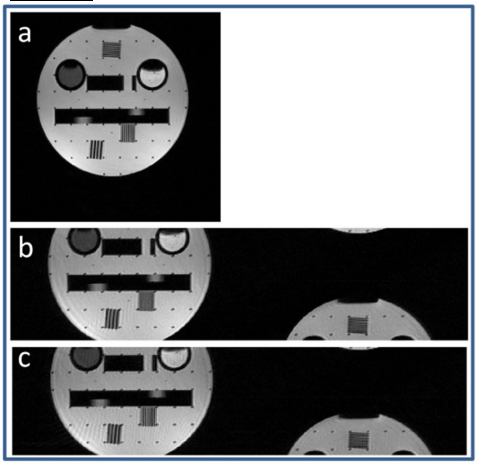

Fig. 2 a) the standard gradient echo imaging, b) the *W*=2 acceleration image acquired by Single carrier Wideband MRI, c) the *W*=2 acceleration image acquired by Single carrier Wideband MRI with blur mitigation.

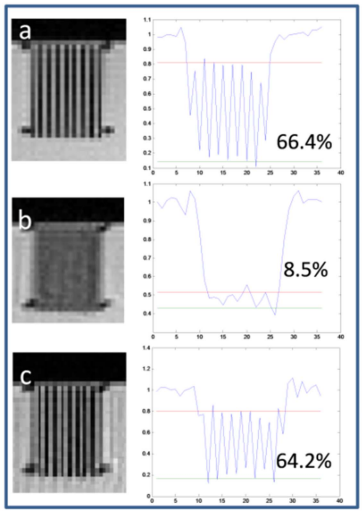

Fig 3. 1mm^2 high resolution structure comparison of a) the standard image produced 66.4% contrast. b) image acquired by *W*=2 Single carrier Wideband MRI, which has only 8.5% contrast. c) the blur mitigated *W*=2 Single carrier Wideband MRI image producing 64.2%

Figure 2 shows the image acquired by a) gradient echo, b) *W*=2 Single carrier acceleration Wideband MRI and c) *W*=2 Single carrier acceleration Wideband MRI with blur mitigation. 1mm^2 high resolution structure of each protocol was used to exam the blurring effect and the results shown in fig 3. The results of standard gradient echo and Single carrier Wideband MRI with blur mitigation has shown a peak-to-valley contrast about 64%~66%, while the Single carrier Wideband MRI without blur mitigation failed to display the high resolution structures, which producing a merely 8.5% peak-to-valley contrast.

Discussion & Conclusion

Our results demonstrate the image characteristics of Single carrier Wideband MRI technique and the blur mitigation, where the blur mitigation has improved the high resolution contrast significantly. Therefore, Wideband MRI could speed up the scan time or alternatively acquire high spatial resolution images with image qualities that is comparable to standard sequences, providing great value in clinical studies. Based on current results, the future work is trying to extend Wideband technique to higher acceleration rate.

References

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