Mobile Coil Array for Interventional MRI

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Abstract

In this work, a high resolution whole mice body image using mechanically sliding coil array was demonstrated for interventional MR. Three fixed coil arrays were situated on the bottom of mice body while the mechanically mobile small coil loop with high S/N, was put on the top of mice head to perceive higher S/N on the volume of interest (VOI). One high SNR quality image of mice head captured by mobile loop and three homogenous quality images of mice body acquired by associated fixed rectangular coils were acquired and used for image reconstruction using parallel imaging to speed up imaging time. Compared with conventional array coils, this design offers more freedom for target detection and offers higher SNR on the target area.

Introduction

Interventional MR imaging requires high spatial resolution on the VOI as well as large FOV at the same time and uses parallel imaging technique to increase temporal resolution. For this specific purpose, we have developed a phased array coil possessed all these characteristics. A mobile small loop coil can observe specific area in high SNR and the others three immobile elements will image whole animal body using parallel imaging to speed up imaging time.

Materials and methods

In our phased array system, we combined a mobile small loop with three fixed large coils, with the small one sliding on the top. The size of the mobile small coil is half to the large one in length. The configuration of the mobile array coil is demonstrated in fig. 1. Small moveable coil posited on the top and the other three large rectangular loops are on the bottom. The three decoupling methods were used in this coil array, overlapped, capacitive and low input-impedance pre-amplifiers (noise figure~1.5 dB, gain~27dB, input R~1 ohm) [2]. The isolation of each channel is below to -15 dB. Eventually, this mobile phased array was tested on Bruker 3T bio-spec system using phantom ($CuSO_4 \cdot 2H_2O$) and mice to evaluate and verify its performance.

Results

In phantom imaging evaluation and verification, as figure 2, it shows that small coil loop compared with three fixed large loops can obtain 2.5 SNR raise using both sum-of-square and SENSE with 2-fold acceleration reconstruction algorithms. In addition, the 4-channel phased array was situated around a 25-mg balb/c mouse. The three fixed large array coil were decoupled between each other with overlap, capacitive and low input-impedance pre-amplifier methods. Gradient-echo images were acquired using 1 mm slice, 9×4 cm FOV, 512×512 matrix, TE = 8.2 ms, TR = 906 ms, NEX = 16. All slices in coronal view are shown as fig.3. These slices as left to right are located from abdomen to dorsum of mice body. High S/N is observed in the brain area where the small coil is located. This high S/N can be used for "zooming" effect for interventional MR applications

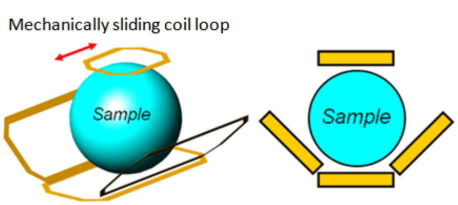

Fig.1. Coil configuration of the moveable phased array. Small mobile coil is on the top of the sample.

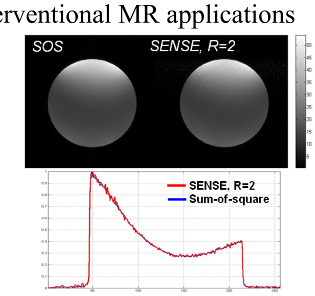

Fig. 2. Both of SOS and SENSE reconstruction algorithms, small loop provides a 2.5 SNR increase on the top of the image in comparison with three fixed large coils.

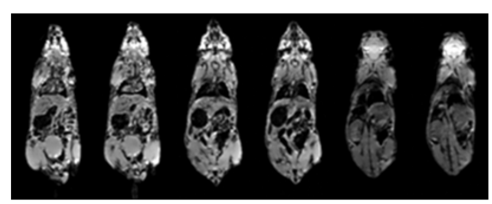

Fig. 3. High resolution images of whole mice body in coronal view. The images from left to right were sliced from abdomen to dorsum of mice. In-planed resolution is 175×78 um^2.

Conclusions

In this present work, we were able to obtain high resolution images for whole mice body successfully. On the other hand, the mobile small loop can detect brain area with higher SNR, so that users can have their own way to observe where they are interested in for interventional MR applications. A mobile coil using HTS(high temperature superconducting) materials can further raise the S/N by several folds and provides even higher spatial/temporal resolution interventional MR in the future.

Reference

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