4 Channel Mouse Array at 7 Tesla.

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Introduction

Parallel imaging studies have been showed to increase the speed and/or the resolution in MRI images, although multi-channel systems are often used without parallel imaging to increase SNR [1]. In animal studies, parallel imaging is becoming more important due to the recent development of multi-channel coil arrays for high field research systems. Most of the coil arrays designs are focused towards rat imaging applications [2]. In this work, we introduce a 4-channel coil array for mouse imaging at 7 T.

Methods

The array is comprised of two pieces with two rectangular coil elements, each of which is aligned on a cylindrical surface along the x-y plane (Figure 1). Each neighboring element in the array is decoupled using a shared conductor with a decoupling capacitor, elements which do not share a conductor are also decoupled with capacitive decoupling [3].

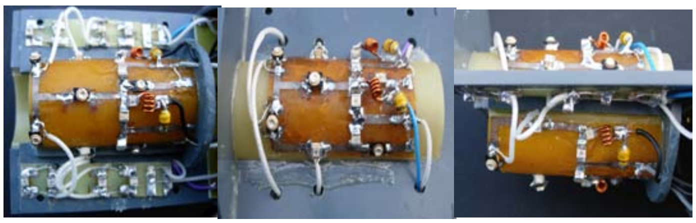

Figure1, Different views of the 4-channel array.

The array is 23 mm in diameter and 27 mm long in z-direction, and is suitable for measuring mice with weights between 20 and 35 g.
Each element is tuned and matched to 50 Ω with a physiological load of 4.7g /mol NaCl. The array is actively decoupled by a 300.3 MHz tuned trap circuit including a PIN diode. As a transmitter, a Bruker 1H quadrature birdcage coil with a diameter of 72 mm was used. The images obtained with the 4-channel coil array were compared with images made using a birdcage with a diameter of 35 mm and a length of 45 mm.

Results

The Q drops by approximately a factor of 2 to 2.5 fold from unloaded to loaded case. Decoupling between neighbors is -20 to -24dB and decoupling between non-neighboring coils is -22 to -26 dB. Active decoupling by the traps is -28 to -34dB. MR images were acquired of the head and chest of a 30gr. Mouse.

In figure 2, a comparison is made between the 4-channel array and the birdcage. Figures 2A and 2B show transverse images of the mouse head obtained with the birdcage and the 4-channel array, respectively (sequence parameters: FLASH, FOV=30x30mm^2, TR=136.7ms, TE=6ms, Slice= 3mm, Matrix 256x256). Figures 2C and 2D shows transverse images of the mouse heart obtained with both coils (FLASH, FOV= 35x35mm^2, TR=126.7 ms, TE=6ms, Slice= 2mm, Matrix =256x256). Figure 4 shows a transverse image of a phantom reconstructed with SENSE [4] for acceleration factors R=2 and R=4.

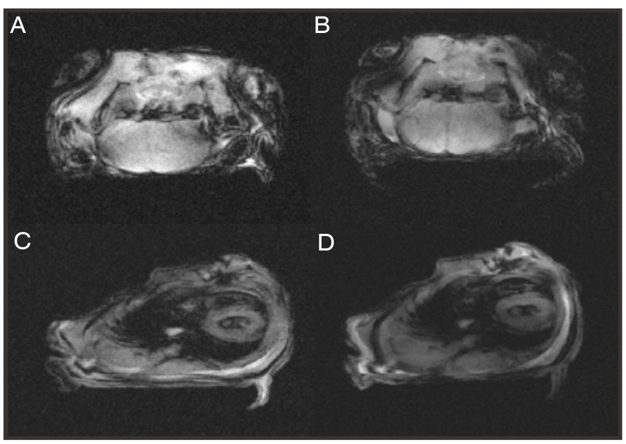

Figure 2, top: images of a mouse head, bottom: images of a mouse heart. (A, C) Images acquired with a birdcage. (B, D) Images acquired with the 4-channel array.

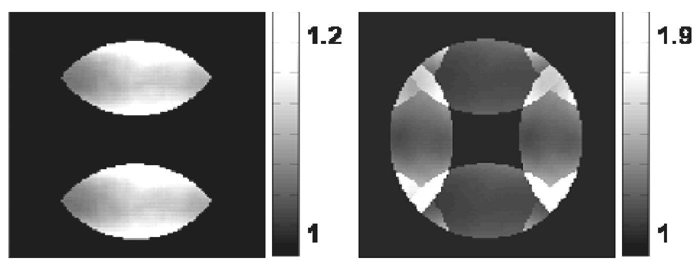

Figure 3, g-maps of the 4 channel array, (A) R=2, (B) R=4.

Conclusion

The 4-channel array coil presented here has been used to measure a mouse in various positions with a higher SNR than a birdcage coil. The array also shows a good homogeneity and RF penetration compared with the birdcage, as well as good performance and decoupling between elements without preamplifiers. In addition, the geometry of this coil is well-suited to the use of parallel imaging, achieving a factor 2 in the x-direction. In addition, for 3D images, the data can be reduced by and additional factor of 2 in the y-direction, yielding a total acceleration of R=4.

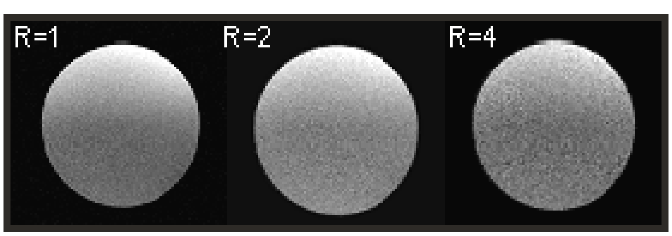

Figure 4, Transverse image of a phantom (4.7g /mol NaCl) with SENSE reconstruction for different acceleration factors.

References

1. PB. Roemer etal. MRM16: 192-225 (1990)
2. T. Lanz etal. Proceedings ISMRM 2006. Seattle, Wa, USA.
3. R.F. Lee etal. MRM48: 203-213(2002)
4. K. Pruessmann etal. MRM42: 952-962 (1999)

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