A 32 Channel Cardiac Array Optimized for Parallel Imaging

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Introduction

The increasing number of receive channels available on today's MR scanners has opened up the possibility of using high performance receive coil arrays with 32 or more coil elements [1-4]. These are especially of high interest in applications such as cardiac imaging where high acceleration factors in parallel imaging techniques can be used for a substantial reduction of scanning time. In this abstract we present a 32 channel cardiac array which is optimized for parallel imaging of the human heart.

Methods

The coil array consists of 32 equivalent single coil elements which are distributed equally in an anterior and a posterior coil halves. In each half, 16 coil elements are arranged in a 2D geometry as shown in Figure 1. Each single coil element is hexagonal with a total size of 10 cm. The coil layout was optimized with respect to coil sensitivity and ergonomics. The posterior array is built into a flat rigid housing, while the anterior array is made of a flexible printed circuit board with PE foam as housing and rigid boxes for component protection. The smallest possible bend radius of the upper array is about 15 cm. The total coverage of the array is 50 cm x 40 cm. The thicknesses of the array halves are 4 cm (posterior) and maximum 3 cm (anterior). Each coil element has a built in low noise high input impedance preamplifier which is located in the center of the corresponding element. The array was tested on a 32 channel Siemens Avanto system.

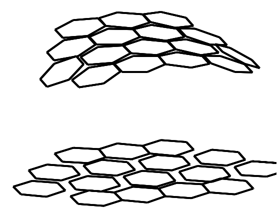

Fig. 1: Layout of individual coil elements

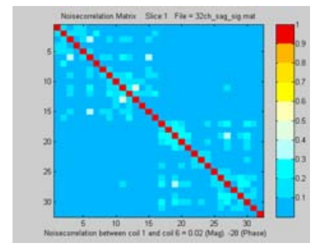

Fig2: Observed noise correlation matrix

Results

The individual elements are all isolated well, resulting in a worst case noise correlation of 40%, with the mean level much below this. (Figure 2.) In vivo TSENSE experiments were also performed to gauge the maximum feasible accelerations. Figure 3 shows 2D gated cine acquisitions ranging from acceleration in the AP direction of R=2 (left, 6 heartbeats), to R=6 (right, 2 HB). Figure 4 shows the results of a 3D cine acquisition with a total acceleration of R=4x2=8. Image quality is excellent even at this level of acceleration. In this case, the mean g-factor was 2.2 with 90% of the voxels having a g less than 3.0.

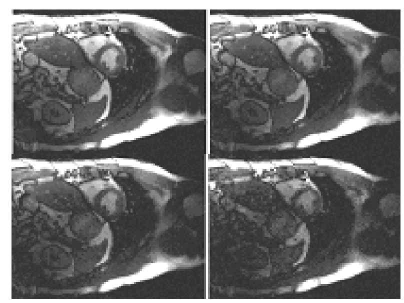

Fig 3: 2D cine images at accelerations of (top, left) R=2, (top, right) R=3, (bottom, left) R=4 and (bottom, right) R=6. Matrix 192x108 at 24.2 ms temporal resolution.

Discussion

It was demonstrated that the presented 32 channel cardiac array is capable of accelerations of R=4 or more in 2D applications in all directions, including AP, which is essential for heart imaging. Further reductions are possible for 3D experiments. These high reduction factors have the potential to allow real-time 2D imaging, or short breathhold 3D imaging. This would bring major relief especially to sick patients, which could bring in a new era of clinical cardiac imaging.

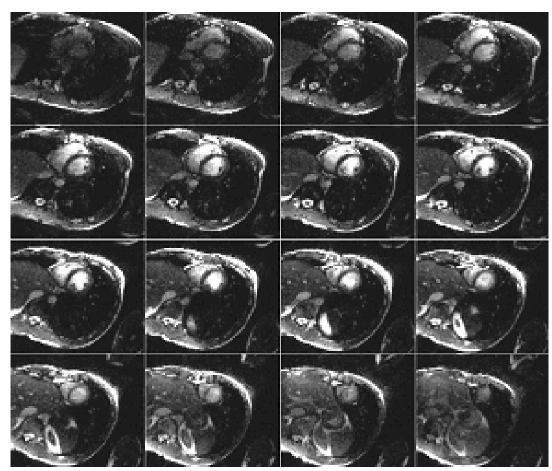

Fig 4: 3D accelerated cine acquisition acquired using 4x acceleration AP and 2x in the slice direction, for a total acceleration of R=8. TE/TR= 1.4/2.8 ms, 50° flip, matrix: 128x104x20 with 25% slice over-sampling (16 total slices), resolution= 2.5x2.6x5 mm^3, 13 views per segment (~40 ms temp. res.).

References

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