

32-Channel Receive Only Array for Cardiac Imaging at 7T

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Introduction: The parallel imaging performance of a 32-channel receive-only array for 7T cardiac imaging is presented below.

Methods: The 32-channel receiver array is composed of two identical 16-channel arrays (fig. 1). Each 16-channel array is comprised of three rows of coils, the first and third row both contain five coils while the middle, or second row contains 6 coils. The overall length and width of the array sets are 33 and 43 cm respectively. Both arrays are housed in Teflon and G10 glass epoxy laminate structures that have a slight curvature to better conform to the torso.

Each individual coil is comprised of Number 10 AWG copper wire formed to a 9 cm circle, soldered to a RT/duroid 5880 high frequency laminate (Rogers Corp, Chandler, AZ) and tuned to

proton's Larmor frequency at 7T (296.8mHz). Nearest neighbor coils had 2 cm overlap. Low impedance preamps (G=20dB, NF= 0.5dB at 300MHz; Microwave Technologies, Fremont, CA) were used for preamplifier decoupling. Both active and passive detuning was used to insure isolation between the transmit array and receiver array during transmit.

Two different volume transmitters were used, the first being a smaller twelve-channel TEM array (1) and a larger sixteen-channel TEM array (2).

Imaging experiments were performed on a 7T ($\omega_0=296.8$ MHz), 90cm bore magnet (Mangex Scientific, UK) equipped with Siemens console and body gradients. Twelve to Sixteen 1KW amplifiers (CPC, Hauppauge, NY) were used for excitation, depending on the transmit array.

Coronal FLASH images (TR/TE=100/6.1ms, res=1.0 x 1.0 x 5.0mm) of the male pelvis were acquired to access the parallel imaging performance. Additionally, ECG-retrograded cardiac FLASH cines (TR/TE=45.2/3ms; res=2.3 x 2.3 x 3.0mm) of the four-chamber view the heart were acquired with reduction factors from 1 (no reduction) to 5 (parallel imaging reference lines=25) in the LR direction. Finally, T-GRAPPA short-axis cardiac cines (TE=1.3ms; res=2.3 x 2.3 x 5mm, R=3 in the AP direction) were also acquired. Each image was reconstructed from 88.5s of sequential data; no breath hold was required in this scan.

Results: Table 1 shows the 2D mean g-factor values for the coronal pelvis image. From the table it can be seen that a 1D reduction factor of 6 along z results only in a mean g-factor of 1.2, this is impressive considering there are only three rows of coils. Similarly a 2D reduction factor of 16 (4 by 4) has a mean g-factor less than 1.2.

Figure 3 shows two slices of the four chamber FLASH cine with no reduction (a) and a reduction factor of 5 (b). A five-fold reduction minimized the acquisition time from 17 seconds down (16 heartbeats) down to 6 seconds (6heartbeats), with no loss of signal quality.

Figure 4 shows 4 (out of 200) slices the reconstructed T-GRAPPA short axis images. This data set was acquired in just over 8 seconds.

Conclusions: As expected this array shows excellent parallel imaging performance. Both the 6-second FLASH cine and 8-second "free breathing" T-GRAPPA cine are clinically viable solutions. Additionally, reduction factors this high could play an important role reducing SAR at high fields.

Reference: ISMRM 2009, p.391.

2) ISMRM 2009, p. 4791.

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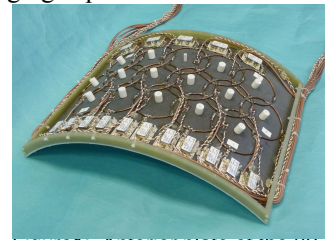


Figure 1: Anterior plate of the 32-channel receiver array.

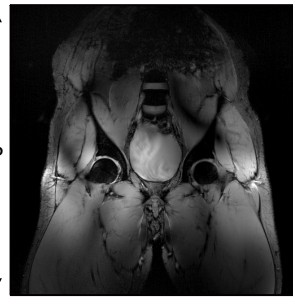


Figure 2: Coronal FLASH image of the male pelvis

	Reduction LR					
	1	2	3	4	5	6
Reduction AP	1	1.00	1.00	1.01	1.04	1.07
	2	1.00	1.03	1.03	1.07	1.11
	3	1.03	1.04	1.06	1.12	1.18
	4	1.06	1.07	1.11	1.18	1.26
	5	1.11	1.12	1.19	1.30	1.42
	6	1.23	1.25	1.34	1.49	1.67
	7	1.44	1.49	1.61	1.83	2.16
	8	1.78	1.85	2.04	2.41	3.00

Table 1: 2D mean g-factors from figure 2

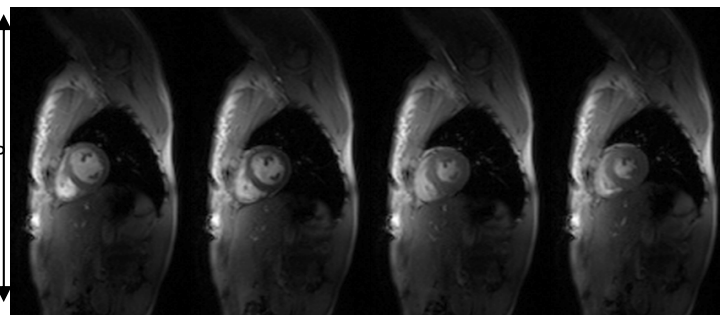


Figure 4: Four Short Axis views of the reconstructed T-GRAPPA cine. This cine was acquired in 8 seconds with a reduction factor of 3 in AP direction

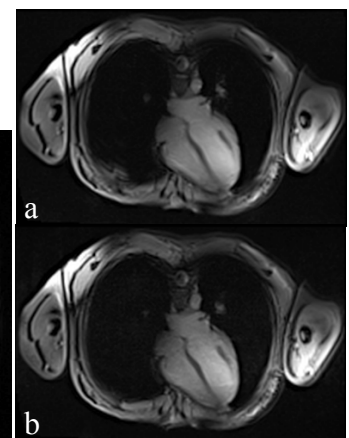


Figure 3: Two slices from the four chambered FLASH cine. (a) has no reduction, (b) has a reduction factor of 5 in the LR direction