28-Channel Receive-Only Array For Body Imaging at 7T

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Introduction: Currently most 7T body imaging is primarily performed with Tx/Rx surface arrays (1,2). However, it is know that using a larger volume array in conjunction with local receivers provides higher spatial sensitivity and SNR when compared to either local transceivers or large transceivers (3,4). Additionally large number of receiver elements has shown to be useful at 3T (5). We believe that a large number or receive-only coils used in concert with a volume transmitter will provide similar benefits. Here, we present our initial findings from a twenty-eight-channel receive-only array, composed of two (an anterior and posterior) fourteen-channel arrays, for torso imaging at 7T.

Methods: Each fourteen-channel array consisted of three rows of coils; the top and bottom rows had five coils each while the middle row only had four (see fig 1). Each coil in the array was individually tuned to proton's Larmor frequency at 7T and matched to 50 ohms. All loops were actively detuned during transmit. Geometric overlap and low-impedance preamplifiers where employed to minimize receiver array coupling (6). The arrays were milled from RT/duroid 5880 high frequency laminate (Rogers Corp, Chandler, AZ). and all elements were circular with an interior diameter of 88.9 mm and a 114.3 mm outer diameter. The overall dimensions of the arrays were 431.7 mm by 365.3 mm. Each array was encased between two 1.6 mm-thick sheets of PTFE. The array was flexible, allowing it to be contoured to the patient.

Two different volume transmitters were used, the first being a smaller twelve-channel TEM array (7) and a larger sixteen-channel TEM array (8).

FLASH images of the male pelvis where acquired (TR/TE: 100/6.1 ms; reduction factor: 4; coronal res: 1.95 x 1.95 x 5.0 mm; axial res: 1.56 x 1.56 x 5.0 mm).

ECG-retrogated cardiac FLASH cines (TR/TE: 54/3.1ms, 1.75 x 1.75 x 7.0mm) were acquired along the short axis view with varying reduction factors.

Results: Figure 1b shows the noise correlation matrix; there is on average, 10% coupling between any two elements in the array.

Figure 2 shows coronal and axial images of the male pelvis. The array has an approximately 40 cm field of view in both the z- and x-direction and approximately 30cm in the y-direction. RF shading, noticed in mostly the axial image is due to the destructive interference patterns during transmit. Additionally, the 4-fold reduction (ipat=4) only requires a total scanning time of 7.5s. Impressively, despite only having three rows of coils in the array, reduction factors of 4 in the z-direction does not lead to signal degradation in coronal image.

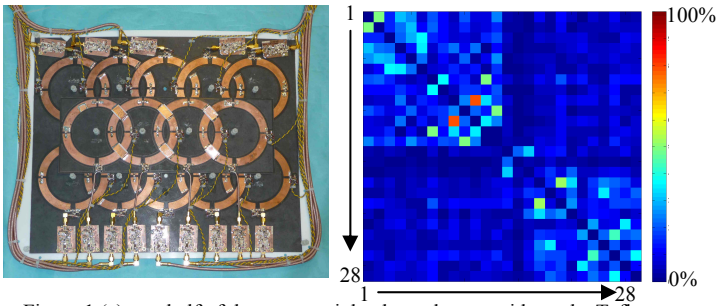

Figure 1 (a) one-half of the twenty-eight channel array without the Teflon cover. (b) Noise correlation matrix showing the receiver array coupling, expressed in percent.

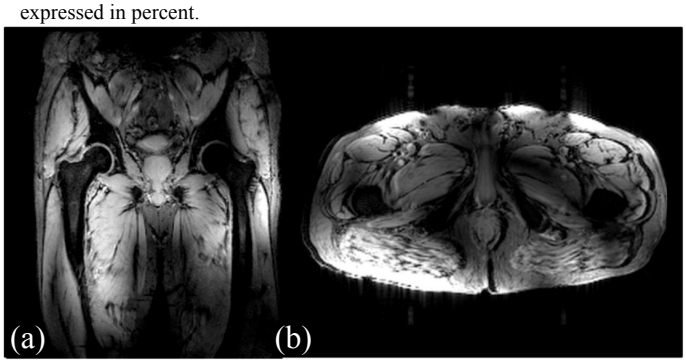

Figure 2: (a) coronal and (b) axial images of the male pelvis. A reduction factor of four was used for both sequences making the acquisition time approximately 7s

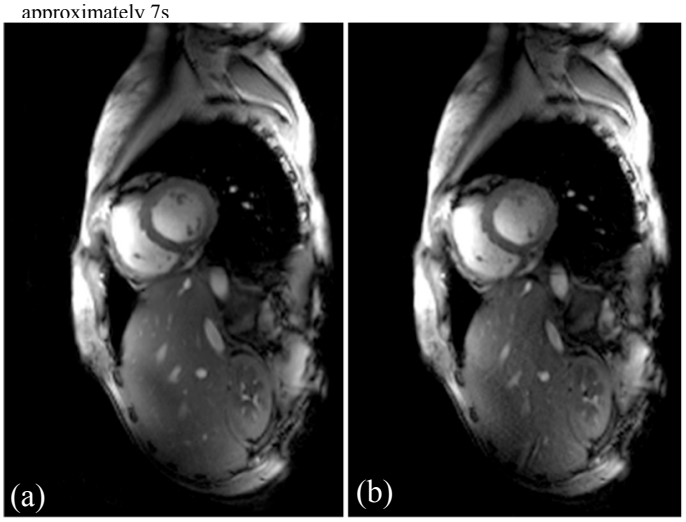

Figure 3: (a)Double-oblique short-axis images of the heart with an acquisition time of ~ 25s, (b) same image with a 4 fold reduction; acquisition time ~6s.

Figure 3 shows the short-axis view of the heart. Figure 3a was acquired in approximately 25 seconds over 22 heartbeats whereas figure 3b was acquired with a 4-fold reduction (ipat=4) in 6 seconds over 6 heartbeats.

Conclusions: We have shown the first use of large number of receiver coils for body imaging at 7T. While more work is required, this array shows early improvements in spatial coverage and spatial encoding over current surface arrays at 7T.

References: 1) Metzger G. et al. MRM 2008; 59:396-409. 2.) Snyder CJ. et al. MRM 2009; 61:512-524. 3) Vaughan JT. et al. MRM 2002; 47:990-1000. 4) Wiggins GC. et al. MRM 2005; 54:235-240 5)Schmitt M et al. MRM 2008; 59:1431-1439. 6)Roemer et al. MRM 1990;16:192-225. 7) Vaughan et al. ISMRM 2009, 391. 8) Snyder CJ et al. ISMRM 2009 4761.

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