7T Tx Body Coil with Rx-Only Insert: Primarily Results

Shailesh B Raval[1], Yujuan Zhao[1], Tiejun Zhao[2], Narayanan Krishnamurthy[1], Sossena Wood[1], and Tamer S Ibrahim[1]
[1]*University of Pittsburgh, Pittsburgh, PA, United States,* [2]*Siemens Medical Solutions, Pittsburgh, PA, United States*

Introduction: Body imaging at 7 Tesla [1] faces considerable challenges such as RF power deposition, high field inhomogeneities, and significant technology development. The goal of this study is to use multi-channel transmit coil to target and excites the nuclei in spatially uniform manner in conjunction with a receive-only insert. In this preliminary study, we utilized 7 Tesla human MRI scanner with a 12-channel transmit array combined with 16-channel receive-only body array that target kidney and liver.

Theory: A 12 Channel transmits body array contains 3 decoupled sets of highly coupled 4-channel arrays. Each one is placed in three sides starting from front, back and right side respectively as shown in figure 1 (top). Each side has 2x2 coaxial elements with matching of minimum -18dB. Each panel has 4 independent Tx channels. Each isolated panel creates independent RF excitation. The 16 channel Rx array as shown in figure 1 (bottom) contains sixteen inductively decoupled surface loops with the size of 10 X10 cm and were distributed evenly to fit in the transmit to cover the region of interest. All the loops have minimum of matching and isolation (between adjacent loops) of -15 dB [2].

Methods: The 12 channel transmit kidney/liver coil was connected to a 7T human scanner and integrated with the 16-channel Rx-only insert. The body phantom was specially made to mimic the muscle properties with conductivity of 0.8s/m. The B1 maps were separately acquired for all 12 ports. Then the optimization method was performed to predict the variable phases of each excitation port of coil. RF pulse was designed using B1 shimming (phase only) algorithm which is used to collect 8 slices that covers the volume of the body phantom. In-vivo 7T images were acquired with the following parameters: TR: 100 ms. TE: 3.64 ms, Slices: 3, base resolution: 192, FOV: 200 mm, reference voltage: 111 voltage.

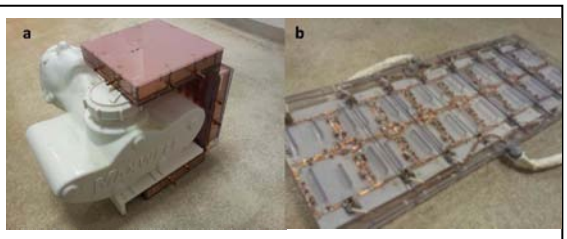

Figure 1. Assembled a) 12-Ch Transmit Body array and b)16-channel Receive insert.

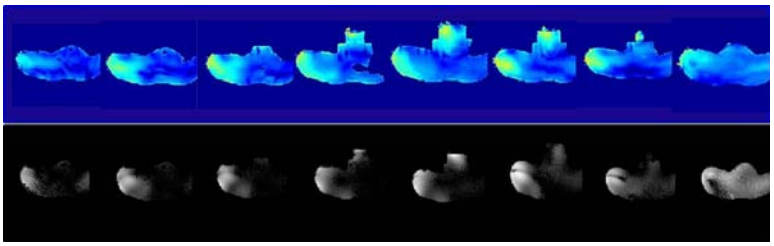

Figure 2. (Top) Optimized B1+ maps throughout homogeneous human body phantom and (bottom) corresponding experimental data obtained at 7 Tesla

Figure 3. Reflection and transmission coefficients for three coil sides on human subject: - Right, Top and Bottom respectively.

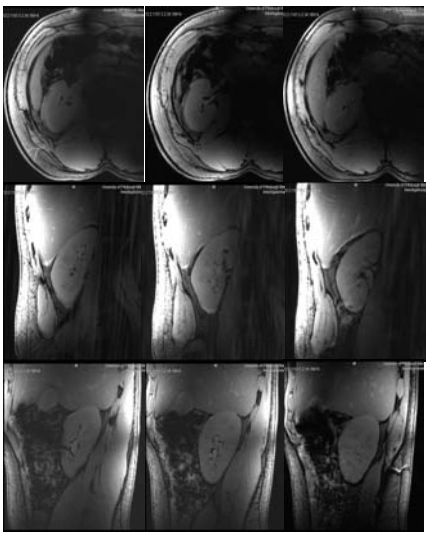

Figure 4. In vivo MR images of the Kidney at 7T.

Results and Discussion: The Optimized B1+ maps throughout a homogenous human body phantom are shown in Figure 2 (top) and corresponding experimental data obtained at 7 Tesla are shown in Figure 2 (bottom). The transmit coil was tuned to human subject at 297.2MHz, and figure 3 shows reflection and transmission coefficients for three coil sides on human subject: - right, top and bottom respectively. Figure (4) shows the in vivo axial, sagittal, and coronal slices of kidney/liver. The initial results show good penetration through the abdomen.

References: [1] 7 T Whole Body Imaging: Preliminary Results, J. Thomas Vaughan, MRM. 2009 Jan., 244–248 2. [2] The NMR phased array, P.B. Roemer, MRM Nov 2005, 192-225.

Acknowledgement: Partially supported by NIH