BOX SHAPED MONOPOLE ANTENNA FOR RF EXCITATION AT 9.4T MRI

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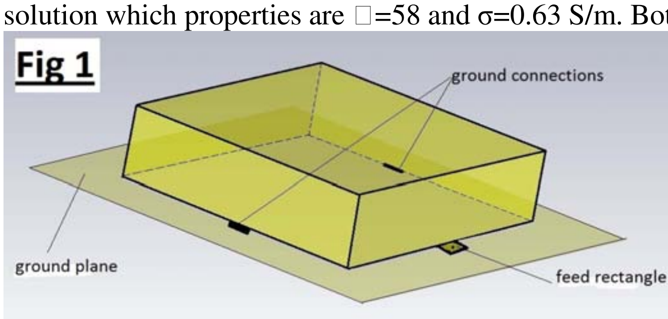
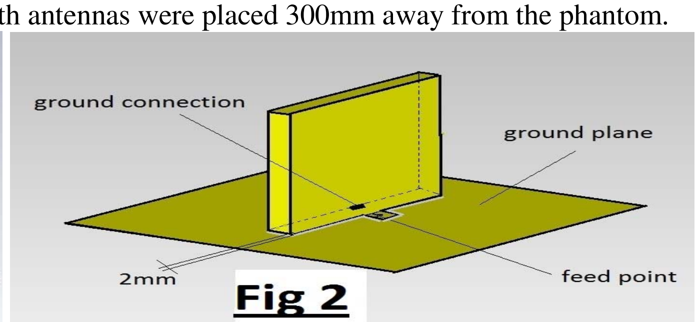
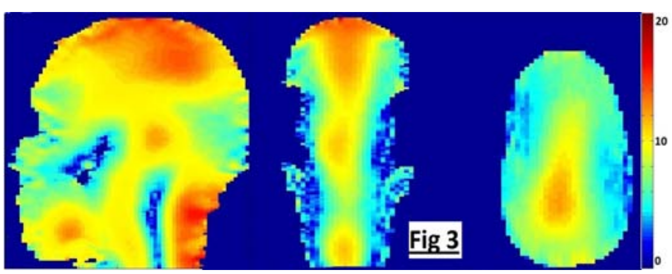
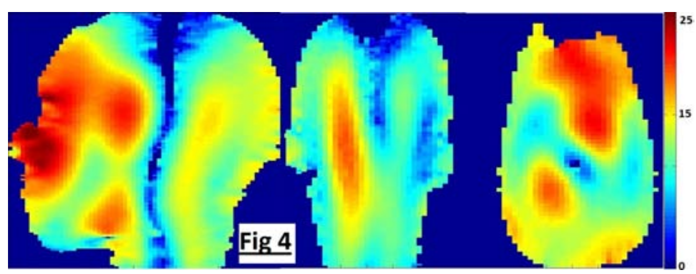
Introduction: The traveling wave approach[1] allows placing antenna away from the subject which improves subject's comfort and provides space for eventual additional hardware to be placed around the subject. Widely used antenna in this concept is patch antenna[1,2]. In this work, we propose two antenna configurations[3] as a potential RF excitation sources in traveling wave approach. Proposed antennas are of very simple structure and without any lumped elements and tuning or matching circuits. Antennas are designed for operation at 400MHz frequency (9.4T MRI scanner). Here we present antennas' geometry and measured B1+ field patterns in central sagittal, coronal and transversal slices.

Methods: Antenna concept used in this work is proposed for the first time in[4] as RF excitation source at 9.4T MRI. Axonometric views of the antennas' geometry are in Figs. 1 and 2. Dimensions of the antenna in Fig. 1 are: ground plane size 320x320 [mm] and box size 210x200x55 [mm]. Dimensions of the antenna in Fig. 2 are: ground plane size 320x320 [mm] and box size 210x20x142 [mm]. Boxes are placed on the piece of foam (for stability) and are 2mm above ground plane. Feed rectangle size is 5x5 [mm] and is parallel to the ground plane. Dimensions of ground connections are 5x2 [mm] and they start 3mm away from the mid-point of the corresponding box side (antenna in Fig.1) and from the mid-point of the 'back' side (antenna in Fig. 2). B1+ field maps are measured on the whole body 9.4T MRI scanner (Siemens Healthcare, Erlangen, Germany). Measurements are performed on head and shoulder phantom which is filled with solution which properties are =58 and σ=0.63 S/m. Both antennas were placed 300mm away from the phantom.









Results: Measured B1+ field in Fig. 3 corresponds to the antenna presented in Fig. 1, while Fig. 4 shows B1+ field of the antenna in Fig.2. In both figures B1+ magnitude is in nT/V. Antenna shown in Fig. 1 is optimized for producing as homogeneous as possible B1+ field in all three cuts (Fig. 3). B1+ pattern presented in Fig. 3 is similar to that of patch antenna[2] but is more homogeneous in the sagittal slice. B1+ field distribution shown in Fig. 4 is significantly different than one in Fig.3 and covers lower brain and neck region.

Conclusions: We proposed a new antenna concept as a potential candidate for use in a traveling wave excitation configuration. Proposed antenna is the simplest possible - entirely made of copper, without any lumped elements and with monopole type feed. Slight changes in antenna's geometry significantly influence B1+ field pattern which allow optimizing antenna design for RF excitation in a specific head regions. Future work would include antenna geometry optimization toward higher efficiency, more homogeneous B1+ field and investigation on the B1+ patterns diversity depending on the geometry adjustments.

References: [1] Brunner DO et al., Nat., 457:994-998, 2009. [2] Hoffmann J et al., Magn. Res. Med., 69:1494-1500, 2013. [3] Zivkovic I and Scheffler K, Prog. Electromagn. Res. PIER, 139:121-131, 2013. [4] Zivkovic I and Scheffler K, 30th Ann. Sci. Meet. ESMRMB 2013, Magn. Res. Mat. Phys. Bio. Med, 26(1):189-190, 2013.