COMPARISON OF MICROSTRIPS AND SURFACE COILS AT 11.1 T AS BUILDING BLOCKS FOR PHASED ARRAY SURFACE COILS

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Introduction

The promise of gains in Signal-to-Noise offered by phased array technology has pushed researchers to continue the development of phased array coils for high field systems, despite the greater complexity, coupling, and general lack of excitation coils. Microstrip construction techniques have been offered as a way to reduce coupling between coil elements in arrays [1-5]. In this abstract, we compare a shunt terminated loop microstrip [4], a tunable loop microstrip [5], and an unshielded surface coil, as well as, microstrips on different circuit board substrates. The implementations were compared as single elements and arrays, and evaluated by their performance in the MRI system and on the bench.

Experimental

We built three coil designs on a microwave substrate (Rogers Ultralam 2000), as shown in Fig. 1; shunt terminated microstrip (hereafter called the Rogers microstrip loop), tunable loop microstrip (hereafter called shielded loop), and an unshielded loop. In addition, we duplicated the Rogers microstrip loop on FR4, a common epoxy laminate. The substrate thickness was 0.060", top conductor width 0.125", and bottom conductor width 0.375". The loops measured 1.2" (3cm) on each side. All loops were tuned and matched to 50 Ω at 470 MHz. Single loops were place on a phantom filled with a tissue equivalent solution [6,7] (ε =48.6, σ =0.6 S/m @470 MHz). HFSS (Ansoft Corp, Pittsburgh, PA), a high frequency circuit simulator, was used to evaluate current density, field intensity, and S parameters (Fig 2).

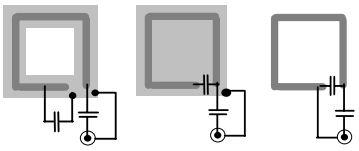

Fig. 1 Microstrip, shielded and unshielded loops

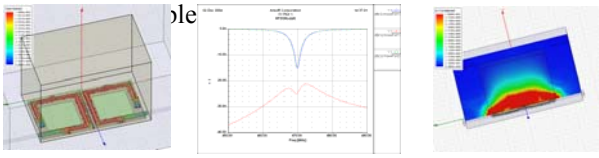

Fig. 2 HFSS geometry, S parameters, and B1 field.

Images were acquired on the 11.1T Magnex magnet (40 cm clear bore) with Bruker Biospec console from which depth penetration and SNR were evaluated. Note, the coils were plugged into standard 50 Ω input impedance preamps.

Results and Conclusions

The Rogers microstrip loop and shielded loop had the highest SNR, 19.2 and 18.5, respectively, followed by the FR4 microstrip loop and the unshielded loop, 14.9 and 13.4, respectively. The Rogers microstrip and shielded loop had higher signal intensity down the axis than the FR4 microstrip and the unshielded loop. Figure 3 shows an *in vivo* mouse image acquired with a smaller 2 element microstrip. The Rogers microstrip loop and shielded loop show superior performance (higher field intensity and SNR) to unshielded loop and FR4 microstrip loop at 470 MHz. Their geometric isolation allows use of standard 50 Ω input impedance preamplifiers in array designs. The improved isolation and ability to use 50 Ω preamps greatly simplifies the array implementation.

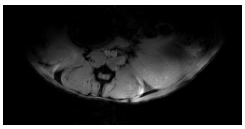

Fig 3. In vivo mouse image

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