

A 3.0T Flexible Transmit and 16 Channel Receive Array Shoulder Coil

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Introduction

For MRI scan of the shoulder anatomy, most of the shoulder coils on the market are receive-only coils, which use the whole body coil in the MRI system to transmit RF power into the human tissue, in which case a large volume of human tissue will be excited and RF power required to do so is high, furthermore, because of the proximity of the shoulder coil to the whole body coil, coupling between the shoulder coil and the whole body coil might cause degradation of signal to noise ratio and uniformity, localized heating may also occur within the receive coil. To address this issue, a shoulder coil design with local transmitter is desirable. On the receive side, in order to optimize SNR performance at deep tissues, an array of small RF coils needs to be positioned close to the anatomy⁽¹⁾, and the shape of the coil needs to be adjustable to fit tightly with a large variety of shoulder sizes⁽²⁾. Based on all of the above consideration, a flexible transmit and 16 channel receive shoulder array coil is developed.

Method

Fig. 1 and Fig. 2 show the receive and transmit elements layout of the transmit receive shoulder array coil. The receive coil consists of three loop-Helmholtz pairs at the center and two wing pieces each consists of 5 loop elements at the side, the total number of receive channels is sixteen. The isolation between adjacent loop and Helmholtz elements are achieved by either critical overlap or inductive coupling, and the coil elements are further isolated with each other using low input impedance preamplifiers. The transmit coil consists of 3 large loop elements, the two loops on the side are combined into a co-rotating Helmholtz coil, and then combined again with the loop element at the center to generate quadrature excitation. The mechanical design of the shoulder coil is shown in Fig. 3: The coil consists of a rigid center piece with inner surface contoured to fit the shoulder curve and two flexible wings on the side, which can be adjusted to fit shoulders with different sizes.

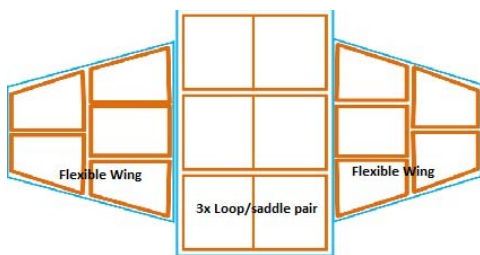


Fig. 1 Layout of receive coil elements

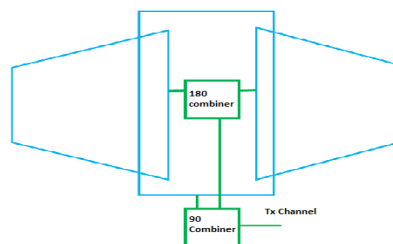


Fig. 2 Layout of transmit coil elements



Fig. 3 Mechanical design of the shoulder coil

Results

The transmit and 16 channel receive shoulder array coil was evaluated on a Siemens Verio 3.0 Tesla system. Signal to noise ratio was measured on a spherical phantom and compared against a commercially available 4 channel receive only shoulder array coil. Results (as shown in Fig. 4) indicate that the two coils have comparable SNR and coverage. A healthy medium size volunteer was also scanned. A selection of images is shown in Fig. 5 and 6. Fig. 5 indicate that the coverage of the coil can reach deep into the tissue and the image quality is very good, Fig. 6 shows that the coil still performs very well even with higher spatial resolution (0.4mmx0.4mm), thinner slices (2mm) and high acceleration factor (IPAT=4). The required transmit voltage for both coils were also compared, the transmit receive shoulder array coil has significantly lower transmit voltage than the receive only shoulder coil (120V vs. 400V).

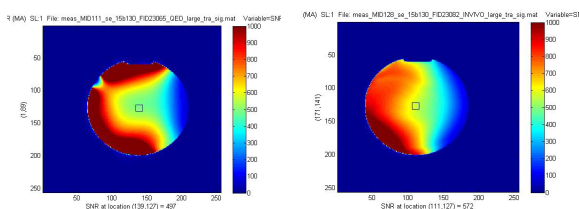


Fig. 4 SNR Comparison on Spherical Phantom, Left: Transmit and 16 Channel Receive Coil; Right: 4 Channel Receive Only Shoulder Coil



Fig. 5 PD TSE with FatSat Coronal 320x288 3mm FOV 16cm



Fig. 6 T1 TSE Coronal 384x288 2mm slice IPAT=4 FOV 16cm

Conclusion

A flexible transmit/receive shoulder array coil was constructed and evaluated on a 3.0 Tesla MR system. Initial results suggest that the coil showed excellent performance in SNR, coverage and parallel imaging, the transmit power requirement is also significantly less than receive only coils.

References

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