Multi-purpose Flexible Transceiver Array at 7T

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Introduction: Flexible array allows for adjustments of coil geometry to best fit the size of subjects, thus, enabling better RF transmission efficiency as well as signal-to-noise ratio (SNR). A daunting challenge in designing such flexible coil arrays, particularly, transceiver arrays, is to achieve and retain sufficient decoupling among the resonant elements under all the geometry/size proposed. In this work, a multiple purpose flexible transceiver array was designed for ultra-high field MRI using a mixing technique of primary and 2nd harmonic microstrips. Besides the coil geometry, the number of coil elements in the proposed design is also selectable for different applications. To demonstrate its feasibility, MR imaging experiments using the flexible transceiver array were performed on a 7T scanner for human wrist, knee, head and liver.

Methods: The major technique challenge when allowing for such multi-purpose flexible array is to find a geometry-independent decoupling solution for coil elements. Due to the requirements of flexibility, the commonly used decoupling schemes, for example coil overlapping, decoupling networks [1-5] are not easily applied. In this work, the primary and second harmonics of microstrip transmission lines are utilized to build the coil elements. By alternatively placing the 1st and 2nd harmonic elements, the nearest neighbors are intrinsically isolated without using any interconnecting LC network circuitry. The coil geometry can be changed by easily done with variable capacitors ranged from 1 to 19pF and on a 7T scanner. The wrist images were calculated for wrist, knee and head (figure 3d). To demonstrate its parallel imaging performance, 3x- GRAPPA of-square method and were shown in figure 3c. To present the good isolation between elements.

Results: After loading with different subjects, the resonance peaks of coil elements are all distinct without splitting, S21 measurements (-dB) between all the elements were shown in fig.3b. Online tuning and matching were easily done with variable capacitors ranged from 1 to 19pF even when loading and coil shapes were changed. GE 7T whole body scanner was used for imaging. This scanner is equipped with two transmit channels, thus sub-images from channels were obtained in turns through multi-times acquisitions and then combined off-line. The wrist images were acquired using these parameters used were GRE 30° flip, TR/TE 150/6.6ms, 256*256, FOV 3*3cm, Slice Thickness 4mm, NEX 4. Parameters for human knee images were GRE 30degree, TR/TE 150/6.9, 256*256, FOV 21*21, Slice Thickness 3mm. For human head we used GRE 30degree TE/TR 6.9ms/100ms, FOV 24*24, slice thickness 3mm, matrix 256*256, NEX = 4. For in vivo liver images we used GRE 30degree TR/TE 150/3.6, 128*256, FOV 35*35, Slice Thickness 5mm, within one breath-hold. Individual channels were combined with sum-of-square method and were shown in figure 3c. To demonstrate its parallel imaging performance, 3x- GRAPPA images were calculated for wrist, knee and head (figure 3d). Eight channel images for the human liver were also shown to present the good isolation between elements.

Conclusions: A multiple purpose, flexible transceiver array at 7T has been demonstrated. The nearly coil-size-independent isolation among elements allows it to be applied in humans for various subjects with different size. Besides the imaging examples demonstrated here, this array is also being successfully used for the ankle and to extend to other possible applications.

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References: