IMPLEMENTATION OF A FOUR-CHANNEL PHASED-ARRAY COIL FOR PATLOC IMAGING

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Introduction: Non-linear local gradients have been introduced for high-magnetic fields to alleviate problems arising from fast gradient switching and resulting peripheral nerve stimulation [1]. This work is focused on the implementation of a self-constructed four-channel phased-array coil for multi-parallel PatLoc imaging to study the non-linear geometry of these fields under realistic conditions. (PatLoc = parallel imaging technique using localized gradients).

Methods: PatLoc gradients are most effective in close proximity to their coil wires. For that reason, radio frequency coils located inside of these gradient coils should be as thin as possible to avoid unnecessary reduction of the available volume of interest. For multi-parallel reception, a four-channel receive array coil with a very thin wall has been created [2]. In combination with a volume resonator such a setup allows the investigation of samples inside of non-linear Patloc fields. Thus, a self-built saddle-coil resonator and, for comparison, a commercial Bruker linear resonator have been tested in that arrangement. Figure 1 shows a sketch of the arrangement of the coils inside the bore of a 9.4 T magnet.

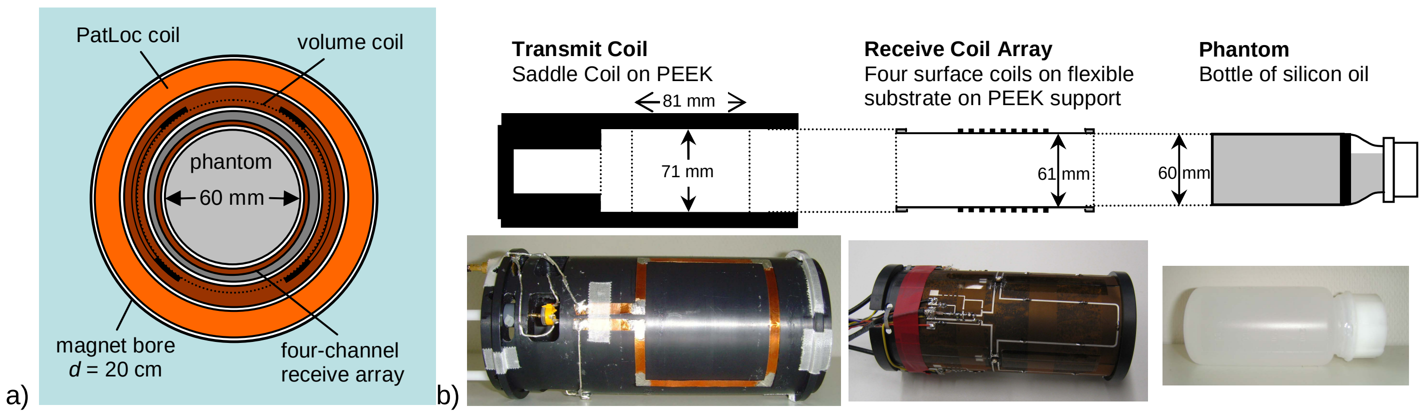


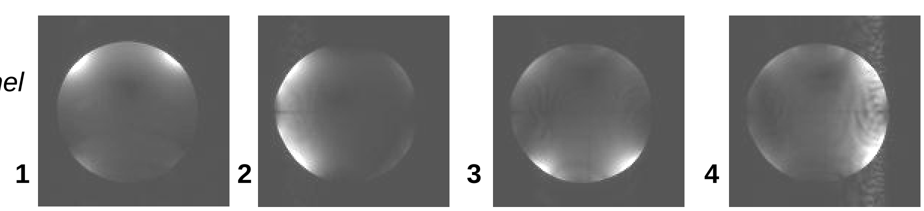
Figure 1: (a) Sketch of cross-section of arrangement of gradient coils, RF transmit and receive coils inside of a 9.4 T magnet with phantom of diameter d = 6 cm; (b) Sketch and photos of side view of four-channel coil

MRI experiments were performed on a Bruker AVANCE II MRI spectrometer, using standard pulse sequences for transceive coils and coil arrays. A four-channel array coil with d_o = 85 mm, d_i = 61 mm, (i.e. a total wall thickness of only 12 mm) has been realized [2] and was successfully tested on a silicon-oil phantom with d_o = 60 mm.

Results: The performance of the transmission coil has been first investigated in transceive mode on a phantom of silicon oil and compared with results from a commercial Bruker linear volume resonator with an inner diameter of d_i = 72 mm. Identical pulse sequences were applied to both coils leading to SNR values of 45 for the commercial coil and around 25 for the in-house-built resonator. These values are acceptable for that simple coil configuration.

The four-channel receive array coil has been incorporated into the in-house-built transmit volume coil (see Fig. 1). Experiments have been performed in array coil mode i.e. the saddle coil acts as a transmit coil for excitation of transverse magnetization, which is detected simultaneously by the coils of the array during detection. Obtained signals for receive coils 1 to 4, respectively, are shown in Fig. 2, clearly illustrating the coil decoupling between adjacent and also opposite coils.

Figure 2: Axial slices of coils recorded simultaneously with a four-channel receive array coil inside of an in-house-built volume resonator



Discussion and Conclusions: Coil decoupling is reasonably well accomplished for the array coil used. However, its performance in the middle of the phantom is somewhat compromised and needs to be addressed by better inter-coil decoupling. On the other hand, this is not critical as PatLoc encoding provides no spatial resolution in the middle of the phantom. In the future, experiments will be performed inside a PatLoc gradient coil.

References: [1] J. Hennig et al., Magnetic Resonance Materials in Physics, Biology and Medicine, 21, 1-2 (2008).
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