Novel Strip-Conductor Internal MRI Coils

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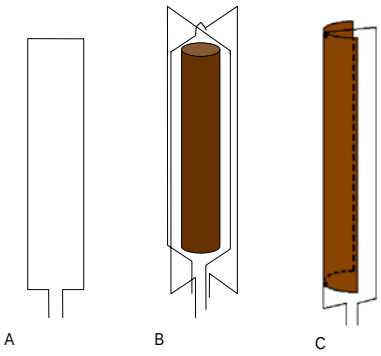
Various disposable internal MRI coils exist for imaging the inner regions of the human body in MRI. The SNR values of the MR images obtained with these coils strictly depend on the geometrical and electromagnetic properties of the imaging coils. Figure A shows a conventional rectangular loop coil. In this work two novel strip-conductor internal MRI coils are designed and implemented.



The first coil is a phased array design. Two rectangular loops were placed perpendicular to each other around a cylinder. (Figure B) A cylindrical strip-conductor was placed in the middle to decrease the coupling between the two loops. The coil was then tested as a dual phased array coil using a phased array adapter. The second design is a single channel coil which is composed of a semi-cylindrical strip-conductor shorted to a wire at one end (Figure C). Unlike the conventional rectangular loop, the sensitivity of the single-channel coil was not symmetrical and was directed toward one direction due to the semi-cylindrical conductor This was intended to reduce the noise resistance due to the electric field distribution and the conductivity of the sample. For comparison purposes all coils were built to the same dimensions and they were matched and tuned with a reflection coefficient less than 0.2 at 63.87MHz using non- magnetic chip capacitors. A diode circuit was used to decouple the receiver coils from the body transmit coil. To reduce the unbalanced currents, each coil was connected to the preamplifier with a balun.

Single-channel and phased array strip-conductor designs were tested in a gel phantom model on a GE 1.5 T scanner. A fast spin echo imaging sequence was used to obtain axial images. An 0.5 S/m conductivity value was obtained by adding 2.2 g/liter of NaCl to the gel solution. The ISNR (W. A. Edelstein et.al., "The intrinsic signal-to-noise ratio in NMR imaging," Magn Reson Med, vol. 3, pp. 604-18., 1986) distribution of the images was analyzed using a MATLAB code.

To show the relative advantages of strip-conductor internal coils over conventional internal coils, the ISNR values of the single-channel and the dual phased array strip-conductor coils were divided by the ISNR of the rectangular loop coil. The maximum improvement obtained by the dual phased array coil compared to the conventional coil was 55% at a point of interest 3.2 cm away from the coil center. For the single-channel design, the maximum improvement of 35% was obtained at 2.5 cm.