

An Open Multi-channel RF-coil Based on a Sectorized Birdcage Approach for 3-Tesla MRI

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Abstract— After a sectorization of an ordinary high pass (HP) birdcage (BC) resonator a multi-element coil with RF shimming capabilities can be generated. Here each element comprises of four rungs spanning an arc of 60° . The separation is simply done by removing the capacitors at the end-ring gaps to the neighboring elements. The homogeneous ground plane is also cut into 6 equal pieces (cf. Fig. 1(b)). Each of the six elements is fed at the central end-ring gap and might be interpreted as a distributed rectangular loop structure with a discrete Cosine current distribution along its rungs (cf. Fig. 1(a)). By simply removing the element that is blocking the patient's view an open 5-channel RF coil with improved comfort is naturally obtained. We will present the design of three coils that are involved in the evolution process (ordinary “continuous” HP birdcage with 24 rungs, sectorized six-element “discrete” birdcage shown in Fig. 1(b), open 5-channel RF coil given in Fig. 1(c)) and compare their performance. Initially, we load each coil with a 20 cm-diameter cylinder phantom ($\epsilon_r = 80$, $\sigma = 0.47 \text{ S/m}$) to find non-ideal field distributions easily. In Figs. 1(d) to 1(f) the circular polarized $|B_{1,+}|$ distribution (normalized to overall accepted power) is shown inside the phantom. The three B_{1+} plots in Fig. 1 indicate a similar performance — except for a slightly reduced strength close to the opening. In the full-length paper, we will consider also asymmetric flat phantoms and inhomogeneous numerical models and investigate the RF shimming capabilities for field optimization (homogeneous $|B_{1,+}|$, minimization of local SAR).

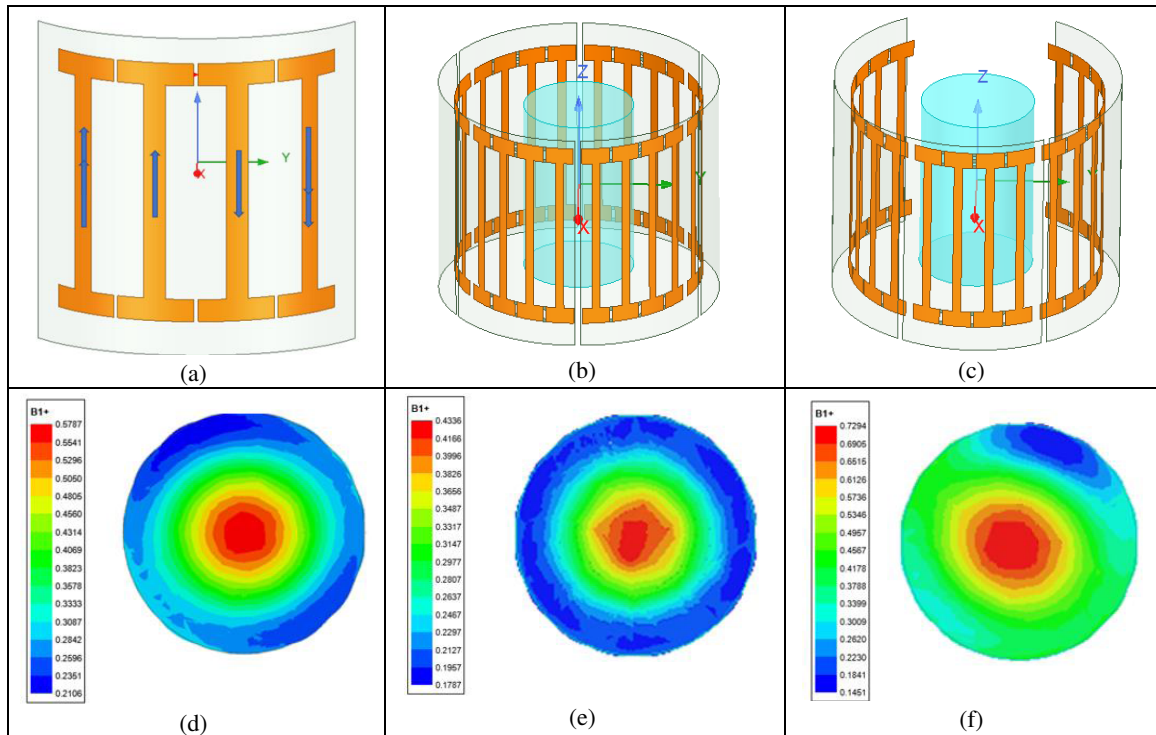


Figure 1: Evolution of quadrature-fed HP birdcage with its $|B_{1,+}|$ as reference in (d) towards open 5-channel RF coil in (c): Sectorization based on new four-rung element (a) with “distributed loop currents” yields 6-channel setup (b), (e) and finally open 5-channel RF coil (c), (f) indicating a comparable B_{1+} performance — except for a slightly reduced strength close to the opening.