Novel transmitter designs for magnetic resonance imaging

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SUMMARY

In this thesis novel transmitter designs for human magnetic resonance imaging for high static magnetic field strengths (7 Tesla) were developed. The theory for both dielectric resonators as well as plasma based resonators have been described in the introduction and outline.

It was shown that by using empirically derived formulas and computer simulations dielectric resonators can be designed also by using water as a dielectric (**chapter 2**). Beside the design itself it was also shown that established techniques in the design of magnetic resonators like the more efficient quadrature drive. Especially a first method to detune the dielectric resonator is essential for the future work of these resonators in magnetic resonance imaging if combination with high density receiver arrays is desired.

In **chapter 3** it was shown that alternative dielectric materials, especially high dielectric materials can be used instead of water. This opens the field for even more compact and more efficient designs. The technology of dielectric resonators for magnetic resonance imaging was further improved by showing solutions for fine tuning ceramic based resonators.

Chapter 4 shows the advanced usage of the technology developed in chapter 2 and chapter 3. Here an array for human cardiac magnetic resonance imaging at 7 Tesla field strength was designed and constructed. The dielectric resonators were used as an alternative to loops as surface coil elements. The performance of the loop coil and the dielectrics resonator was compared and showed similar performance for both designs.

In **chapter 5** a first practical design for a plasma based transmit coil for magnetic resonance imaging was demonstrated. It was shown that it is possible to guide a surface wave via the plasma sheath within the magnetic resonance imaging system.

The thesis ends with **chapter 6** a general discussion and an outlook to possible future developments. Both new resonator designs that were investigated in this thesis have still a lot of potential for improved future designs and and innovations. Especially the combination of dielectric resonators with receive arrays, an alternative coupling scheme and improved dielectrics are fields of interest for future research. As the theory of both plasma and dielectric resonators is well understood improved practical designs are desirable as a next step in this field of research on transmitter designs for magnetic resonance imaging.