Four-Channel Phased-Array (PA) or Quadrature RF Coil for MR Imaging

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Purpose: The purpose of this paper is to propose four-channel PA or quadrature RF Coils for MRI with optimized size and shape for high spatial resolution and good SNR. The proposed 4-channel PA/ quadrature RF coils can be operated either for a one-channel receiver or for a two-channel receiver, or even for a four-channel phased-array receiver. In this paper, two kinds of coils are designed and implemented, which are T-E-E (TMJ-Eye-Ear) RF coil and Breast RF coil. The coils have been implemented for receive-only mode, and tested experimentally. Experimental results show the utility of the proposed RF coils.

Materials and Method: The coil consists of two quadrature coil sets. Each coil set is operated in the quadrature mode to improve SNR by using two RF coils in combination. The benefit to be gained from the quadrature mode RF coil design is a 41% improvement on SNR. Each of the breast or T-E-E RF coils consists of 4 coils, which make two quadrature coils or 4-channel PA elements. By appropriately overlapping two surface coils, the mutual inductance between any two elements among the four coil elements are forced to zero. All the coils are tuned to 42.58MHz for a 1.0 Tesla MRI system and are electrically decoupled during RF transmission through the body RF coil. Each coil is connected via a matching circuit to a low-noise preamplifier. The quadrature signal components are combined in phase and fed to the RF receiver.

Results: The dimension of the proposed coils have been optimized to provide the maximum signal for the TMJ, eye, ear, or the breast. Although the surface coil is an inherently inhomogeneous receiver whose signal reception falls off at depth, the proposed coils have a relative good homogeneity with good SNR. The images obtained using the constructed coils show 5-6 times better SNR than that of the head or body coils.

Conclusion: The constructed 4-channel PA/ quadrature RF coils are useful for MR imaging of the TMJ, eye, ear, or the breast. Its utility has been verified experimentally by using a 1.0T MRI system (Medison Magnum 1.0T).

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