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Technology Offer

Optimization of Multi-Channel Coil for Magnetic Resonance Imaging

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Magnetic resonance imaging (MRI) requires optimal radio-frequency (RF) coil performance that ensures the highest RF magnetic field per unit power delivered to the coil, while maintaining the highest achievable RF field homogeneity. For MRI at high magnetic field level, it is important to use a multi-channel transmit coil for producing the desired RF field. However, it is impossible to design a multi-channel coil without considerable coupling between its coil elements. The major challenge in multi-channel coil design is the difficulty in the design of electromagnetic (EM) coils in which coupling compensation performance is independent of coil loading. A coil's magnetic field approaches a maximum when the RF power reflected by the entire coil approaches its minimum at the NMR resonance frequency. There is no standard commercial devise for measuring the power reflected by the multi-channel RF coils that can be used for its minimization.

Technology

The technology presents a reliable and fast method for performance optimization of a multi-channel coil based on direct minimization of the power, which is reflected at the resonance frequency.

Advantages

- **Direct minimization of the power**: The technology presents performance optimization of a multi-channel near-field RF coil, which is simultaneously excited by at least two power signals with fixed amplitude and phase, by direct minimization of the power ($P_{ref,coil}$) at the resonance frequency.
- **Simple installation of a measuring device**: A device, which measures the power reflected by the RF coils, is installed between the power source and the input coil.
- **Adjustable and replaceable coil components**: Power reflected by the entire coil depends on the value of the adjustable and replaceable coil components, including EM coupling compensation components. Thus, by changing these values, $P_{ref,coil}$ can be easily minimized.
- **Easier protocol**: The method requires measurement of the power reflected by each coil input as a scalar quantity. This procedure is simpler than the existing process of the S-parameter matrix measurements.
- **Precise estimation**: The simplicity of the scalar measurements ensure precise estimation of the power and makes the power guided performance optimization of a multi-channel near-field RF coil suitable for real application.
- **Insensitive to the load dependence**: The method described is insensitive to the load dependence of the coil performance. Furthermore, if tuning of the coils cannot be performed on-site due to safety issues; the coil performance can be pre-optimized taking into account a set of expected load conditions.

- **Coils are independent of each other**: Power signals can be varied independently for each coil as well as for the entire coil.

- **Monte Carlo approach**: The coil is first tuned experimentally to obtain the minimum power for nominal input power amplitude and phase. The coil with tune and feed condition thus derived is analyzed experimentally by a Monte Carlo approach to obtain the dependence of the power on the amplitude and phase of the voltage at each input of the coil.

- **8-channel MRI coil**: Optimum MRI coils (Figure 1) are designed for human subjects.

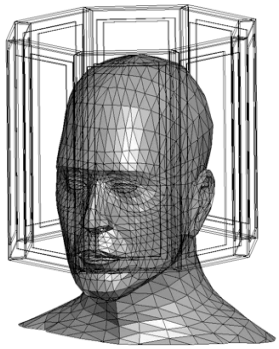

Figure 1. 8-channel MRI coil surrounding the head of a human being.

Patent Information

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