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Electrical Auto-tuning for Ultra-High-Field MRI RF Coils (20120119, Dr. Tommy Vaughan)

Technology No. 20120119

IP Status: Issued US Patent; **Application #:** 13/868,014

MRI Real-time, Automatic Tuning

A new method automatically adjusts electrical performance of radiofrequency (RF) coil assemblies of magnetic resonance imaging (MRI) systems during the medical imaging process of a subject in order to control changes in loading conditions of the RF coil caused by the subject during the imaging process. Automatically tuning the RF coil circuits provides real-time tuning that electrically maintains impedance matching conditions under various human anatomies. The method first measures a reflected signal of the RF coil, determines an adjusted (tuned or detuned) condition, and then adjusts matching capacitor array banks. The technology employs a fast tuning and matching procedure and offers robust performance (regardless of differing anatomy types) and a simple structure that can be integrated a small board or semiconductor chip.

Improved MRI Quality without Technician Intervention

When a human subject is placed in an MRI scanner, a body “loading” effect degrades image fidelity by shifting the Larmor frequency and reducing the quality factor (Q). In current high-field (3T) clinical scanners, this effect can be largely ignored, but as emerging parallel transmit techniques become more prevalent at 3T and the industry moves to higher field strength systems (>3T) it must be addressed. In current pre-clinical multi-channel parallel transmit systems and UHF MRI systems (>3T) the manual tuning step to adjust for loading adds several minutes to the imaging procedure and requires skilled technician intervention, both of which are expected to hinder clinical adoption of >3T MRI scanners and multichannel parallel transmit systems. With this new method, in only seconds each RF coil element in the auto-tuned circuit can be electrically tuned without technician intervention. A control circuit adaptively determines the optimal tuning conditions and electrically tunes the system. This new approach offers improved image fidelity, which enables more accurate diagnosis and clinical diagnostics not previously possible, and will likely be required for market acceptance of

clinical 7T scanners and emerging “full” multi-channel parallel transmit systems.

BENEFITS AND FEATURES:

- Fast tuning and matching procedure
- Robust performance (regardless of differing anatomy types)
- Simple structure that can be integrated a small board or semiconductor chip
- Algorithm and control block integrated into a semiconductor chip
- Enables more accurate diagnosis and clinical diagnostics not previously possible

APPLICATIONS:

- Magnetic resonance imaging (MRI)
- 3T systems with a greater number of channels (>2)
- 7T systems
- Diagnosis and clinical diagnostics not previously possible
- Clinical applications

Phase of Development - Prototype dev

Researchers

Tommy Vaughan, PhD
Professor, Biomedical Engineering, Columbia University
Anand Gopinath, PhD
Professor, Department of Electrical and Computer Engineering
External Link (ece.umn.edu)

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