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Simultaneous RF Signal Transmission and Reception in MRI (20160420)

Technology No. 20160420

IP Status: Issued US Patent; **Application #:** 15/872,068

In vivo Simultaneous Transmit and Receive

A new technology allows first-ever in vivo magnetic resonance (MR) imaging with simultaneous transmit and receive (STAR). The process employs a feedback system with real-time load compensation that enables in vivo simultaneous transmit/receive (Tx/Rx) images. The RF front-end and coil subsystem maintains high isolation over variable loading conditions. Phase and gain adjustments facilitating per-experiment load centering of this isolation demonstrated safe and successful human head imaging in vivo in a 4T MRI system. The load-insensitive design uses a feedback system to compensate load shifts during MR experiments. Fast decaying spin-to-spin imaging means there is no delay between Tx and Rx, so it can measure any signal regardless of decay time. Ultra-low RF peak power uses a continuous wave (CW) mode, which transmits and receives RF signals at the same time. Significantly, only 50 mW peak power over a 10-minute image acquisition was used. The use of ultra-low RF peak power offers great potential for the future development of a compact, low-cost, and safe MRI scanner.

Reduces Peak Power and SAR

MR imaging based on simultaneous excitation and reception has great potential but has suffered from significant sensitivity to load (e.g. motion, respiration, swallowing, etc.). Until now, live in vivo simultaneous Tx/Rx (transmit and receive) experiments were not possible. Current MRI scanners transmit an RF pulse, wait a short period (dead time) and then receive a very small, decaying signal. This new technology features a feedback circuit implemented in hardware that cancels leakage signals, thus providing isolation between transmit and receive and allowing both to occur simultaneously. In addition, this new approach offers significant reductions in peak power and power deposition (specific absorption rate, or SAR) as well as an increased ability to image fast decaying signals for greater diagnostic capabilities.

BENEFITS AND FEATURES:

- In vivo simultaneous transmit/receive
- Load-insensitive design uses a feedback system to compensate load shifts

- Ultra-low RF peak power: significant reduction in peak power requirements (1% of that required in pulsed imaging) and specific absorption rate (SAR)
- Continuous wave mode transmits and receives RF signals at the same time
- Fast decaying spin-to-spin imaging: no delay (100% duty cycle) in waiting time between Tx and Rx; measures any signal regardless of decay time
- RF front-end and coil subsystem maintains high isolation over variable loading conditions

APPLICATIONS:

- Add-on hardware or pre-installed on MRI scanner
- Magnetic resonance imaging and spectrometer
- General wireless communication using simultaneous transmit and receive applications (e.g., RFID, MIMO Wi-Fi)

Phase of Development - Working prototype; in vivo data

Researchers

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Publications

A Compact, High Power Capable, and Tunable High Directivity Microstrip Coupler
IEEE Transactions on Microwave Theory and Techniques, Vol. 64, issue 10, pp. 3217-3223, 12 September 2016

External Links

Center for Magnetic Resonance Research

Interested in Licensing?

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