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Beam Steering Resonance along a Spatiotemporal Trajectory for MRI (20120060, Dr. Michael Garwood)

Technology No. 20120060

IP Status: Issued US Patent; **Application #:** 14/174,368

Combines Spatialtemporal Encoding MR Pulse Sequence with RF Transmit Front End

A new magnetic resonance imaging (MRI) approach uses a spatiotemporally-encoded MRI pulse sequence (e.g., SWIRLY and/or STEREO) in combination with a smart, adaptive, or phased RF transmit front end. Combining these two components allows highly spatially localized regions of uniform excitation, even in the presence of B_0 and B_1^+ inhomogeneities. The transmit front end is comprised of a multichannel transmit array and multiple RF power amplifiers; each amplifier has dynamic phase and gain control over the output waveform. In addition, by exciting only a small region at any given time and allowing more freedom to optimize selected parameters, the technology is expected to reduce specific absorption rate (SAR).

Suppresses Destructive Interference Patterns at Ultrahigh Field Strengths

Beam forming techniques (e.g., B_1^+ shimming or Transmit SENSE), while previously shown in MRI, use a “static” B_1 shim or are based on k-space (Fourier) formalisms. In certain applications, these techniques are not optimal because they cannot avoid exciting signal outside the region of interest. Spatiotemporal imaging methods like STEREO (also known as SWIRLY) can achieve spatially-selective excitation while simultaneously compensating for B_1 and B_0 inhomogeneities. When combined with an RF front end that dynamically shims the RF B_1^+ field and dynamically changes the B_1^+ shim throughout the pulse sequence, these spatiotemporally-encoded MRI methods can further avoid destructive interference patterns typically seen in imaging sequences at ultrahigh field strengths. And as field strength continues to increase, current B_1^+ shimming techniques for homogeneous transmit pattern will fail in the body (possibly even the head) because of the reduced wavelengths in the body, whereas this method will actually benefit from this better defined basis set.

BENEFITS AND FEATURES:

- Allows highly spatially localized regions of uniform excitation, even in the presence of B_0 and B_1^+ inhomogeneities
- Beam-steering improves the ability to compensate inhomogeneities in the radiofrequency (RF) field in spatiotemporally-encoded MRI techniques like STEREO
- Suppresses destructive interference patterns currently seen in imaging sequences at ultrahigh field strengths
- Improves image quality
- Transmit front end comprised of multichannel transmit array and multiple RF power amplifiers
- Expected to reduce specific absorption rate (SAR), “tissue heating”
- May reduce the cost of amplifiers
- Significantly lower power requirements (i.e., as compared to Transmit SENSE)

APPLICATIONS:

- Magnetic resonance imaging (MRI)
- MR imaging
- Potential for ultra high field MRI (≥7T)
- Low-cost MRI scanners
- Under-served clinics and hospitals that cannot afford high-cost 1.5T or 3T MRI scanners
- Imaging at high magnetic fields where B_1 and B_0 inhomogeneities are particularly challenging
- Specialized scanner market segments (e.g., breast, dental, extremity, etc.)

Phase of Development - Proof of Concept

Researchers

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