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

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# 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:**

- ullet 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:**

# Technology ID

20120060

# Category

Engineering & Physical
Sciences/Instrumentation,
Sensors & Controls
Engineering & Physical
Sciences/MRI & Spectroscopy
Life Sciences/Diagnostics &
Imaging
Life Sciences/Human Health
Life Sciences/Medical Devices
Life Sciences/MRI &
Spectroscopy
Software & IT/Algorithms
Agriculture &
Veterinary/Veterinary Medicine

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- 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
- ullet Imaging at high magnetic fields where ullet and ullet 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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#### **Interested in Licensing?**

The University relies on industry partners to scale up technologies to large enough production capacity for commercial purposes. The license is available for this technology and would be for the sale, manufacture or use of products claimed by the issued patents. Please contact us to share your business needs and technical interest in this MRI technology and if you are interested in licensing the technology for further research and development.