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# Magnetic Resonance Electrical Properties Tomography (20130259, Dr. Bin He)

Technology No. 20130259

**IP Status:** Issued US Patent; **Application #:** 14/245,145

## Non-Invasive and High Spatial Resolution in Vivo Imaging of Electrical Conductivity and Permittivity of Tissues

A spatial gradient based electrical property tomography (EPT) method uses magnetic resonance imaging (MRI) to produce non-invasive and high spatial resolution in vivo imaging of electrical conductivity and permittivity of biological tissues. Electrical properties are determined based on estimated radiated gradient values of the electrical properties of the object. For example, electrical property maps are reconstructed using a spatial integration on gradient values estimated from the magnitude and relative phase values derived from measurements of multiple transmit and receive B1 fields. Using a 7 Tesla MRI system, results report high-quality in vivo human brain electrical property images with refined structural details, which can potentially merit clinical diagnosis such as cancer detection. Furthermore, a G-algorithm uses B1+ maps to generate specific absorption rate (SAR) maps that can also be produced based on the estimated electrical properties.

## Gradient-Based Electrical Property Tomography Approach May Accurately Measure Local SAR

The FDA places guidance limits on heating and specific absorption rate (SAR) in humans during magnetic resonance imaging (MRI), but there is currently no way to measure SAR locally. Generic numerical SAR models, which are not patient-specific, estimate worst-case values. As a result, MRI pulse sequences are often designed conservatively with large safety margins, potentially hindering the full potential of high-field systems. In addition, current electrical properties tomography (EPT) techniques generate SAR maps that are too noisy to be useable. Electrical property tomography (EPT) holds promise for non-invasive and high spatial resolution imaging of the electrical conductivity and permittivity of biological tissues in vivo using a magnetic resonance imaging scanner. This technology is a novel gradient-based EPT

approach with greatly improved tissue boundary reconstruction and largely elevated robustness against measurement noise compared to existing techniques. It also features a novel EPT G-algorithm that generates SAR maps, based on conductivity and permittivity, with potentially sufficient fidelity to accurately measure local SAR.

**BENEFITS AND FEATURES:**

- SAR maps based on conductivity and permittivity potentially have sufficient fidelity to accurately measure local SAR
- Installed on MRI scanners or software upgrade
- Increases patient safety
- Exploits full potential of MRI scans
- Improves safety of implantable devices in MRI
- Improves performance of high field MRI
- Noninvasive mapping cancer for early diagnosis
- Additional features as needed

**APPLICATIONS:**

- High field MRI scanners (1.5T, 3T, 7T or above)
- In vivo imaging of electrical properties of biological systems
- Cancer detection/diagnosis
- Quantifying SAR and heating in biological systems within MRI

**Phase of Development** - Pilot Scale Demonstration

**Researchers**

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**Publications**

*Gradient-based electrical properties tomography (gEPT): A robust method for mapping electrical properties of biological tissues in vivo using magnetic resonance imaging*
*Magnetic Resonance in Medicine*, 11 September 2014 DOI: 10.1002/mrm.25434