Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Rosalind Sadleir

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Multi-Frequency Magnetic Resonance Electrical Impedance Tomography

-Low-frequency electrical properties of biological tissues provide sensitive and valuable cellular information as well as the presence or absence of disease. Measurements of variations in these properties provide a unique view of tissue state. Unfortunately, most efforts to image tissue electrical properties in the 10 Hz to 500 kHz frequency range are invasive and often error-prone. While some magnetic resonance-based methods of imaging electrical property distributions have been described, they can only be used at very high (>100 MHz) or very low (<100 Hz) frequencies.

Professor Rosalind Sadleir, at Arizona State University, has developed a novel MRI method that creates high-resolution imaging of electrical conductivity distributions at frequencies between low and high frequencies. This method enables non-invasive imaging of properties to aid in cancer diagnoses and help in planning cancer treatments. This technique has been validated using computational models, cell and tissue phantoms and in-vivo using a rat model of glioblastoma.

This innovative MRI method realizes high-resolution imaging of electrical conductivity distributions to enable non-invasive imaging to aid in both cancer diagnosis and treatment.

Potential Applications

- Cancer detection, response characterization and monitoring
- Planning and monitoring electrical therapies, particularly for treating brain cancers
  - Electroporation and transcranial electrical stimulation
- Diagnosing ischemic stroke
- Neuromodulation treatment planning
- Research to better understand tumor properties

Benefits and Advantages

- This approach can distinguish spectral effects
- Imaging of electrical properties combined with electrical spectroscopy allows for subtle examination of both spatial and time-dependent tissue

characteristics which may be important in the diagnosis and therapy regimen of cancers and other diseases
- Non-invasively image electrical spectra over the frequency range from 10 Hz to 500 kHz at high resolution
- The ability to understand tissue electrical conductivity dependence below 1 MHz results in improved sensitivity and specificity in planning and monitoring electrical therapies

For more information about the inventor(s) and their research, please see

Dr. Sadleir's departmental webpage