LA-UR 10-00265

Licensable Technologies

MAGVIZ: Ultra Low-Field Magnetic Resonance Imaging (MRI)

Applications:

- Airport security screening
- Fieldable, affordable MRI
- Brain imaging and research
- Food and beverage processing

Benefits:

- Direct imaging of chemical environment
- Non-invasive detection and identification of unknown materials
- Imaging through all container materials and colors or through stacked containers
- Safe for use on patients with implants, embedded shrapnel
- ULF-MRI signals not dominated by effects from blood chemistry
- Compatible with functional neural measurements,
- May provide enhanced sensitivity to neural signal measurement compared to traditional MRI

Contact:

Rob Dye
(505) 667-3404
rcdye@lanl.gov

Erica Sullivan
(505) 667-9219
eab@lanl.gov

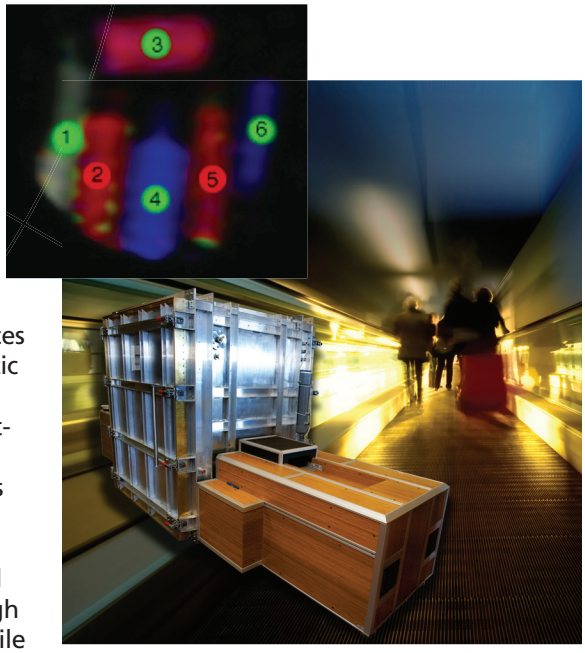
Technology Transfer Division

Los Alamos NATIONAL LABORATORY ESTABLISHED 1943

Summary:

Ultra-Low Field Magnetic Resonance Imaging (ULF-MRI) is an imaging technique that utilizes magnetic fields up to one million times smaller than traditional, high-field (HF) MRI machines currently found in most hospitals. ULF-MRI is enabled by Superconducting Quantum Interference Devices (SQUIDs), ultra-sensitive magnetic field detectors, which eliminate the need for large superconducting electromagnets used in HF-MRI units, which greatly reduces the size and cost ULF-MRI units. Because it utilizes very small magnetic fields, ULF-MRI is ideal for non-invasive imaging through metal or opaque containers, while retaining the primary strength of traditional MRI: the ability to probe chemical environments as well as provide images.

Initially developed at LANL to advance research in brain activity by detecting ultra-weak magnetic fields emanating from the brain, ULF-MRI has now been applied to multiple applications, including medical imaging, food processing and homeland security.



MagViz scans liquid items such as those travelers typically carry on aircraft and assesses them for threat materials by matching the proton signals from the scanned items to those in a database of benign and 'threat' liquids. This MRI image shows six liquid-filled containers, along with their computer generated tags: green for benign liquids, red for threat liquids, and yellow for undetermined liquids. The liquids are (clockwise from the top) sunscreen, benzoil peroxide, high volume hydrogen peroxide (explosive), hand sanitizer, high-volume hydrogen peroxide (explosive), and shampoo.

MRI is a powerful diagnostic tool for soft-tissue anatomy and injuries and is commonly found in hospitals. Its relatively small size and low cost makes ULF-MRI instrumentation ideal for fielded applications, such as battlefields and remote or mobile medical clinics. Additionally, by employing ultra-low magnetic fields, ULF-MRI is safe for use in patients with medical implants, pacemakers or embedded shrapnel because metal objects will not dislodge under the magnetic fields, a significant advantage both in the field and in emergency rooms where patient history may not be known.

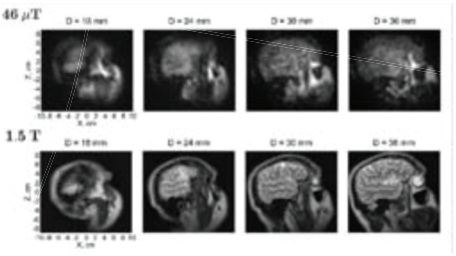
In additional to anatomical imaging for diagnostic purposes, ULF-MRI provides a new neuroimaging approach which will give researchers a better understanding of the nature of cognition, which in turn could lead to an increased understanding of how the brain works. The same SQUID sensors used in ULF-MRI can be used to detect minute changes in magnetic fields resultant from the presence of brain activity. The combination of neural signal detection with anatomical imaging via ULF-MRI may provide a new imaging tool for studies of the ignition point of visual recognition, cognition, or deception. In addition, the direct imagining of neural activity may lead to new diagnostic tools for neural diseases like epilepsy.

www.lanl.gov/partnerships/license/technologies/

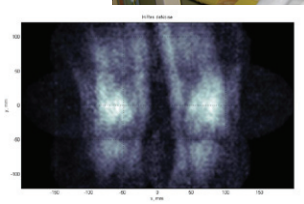
01/10

MAGVIZ continued

ULF-MRI can also be used to non-invasively investigate the chemical environment inside all types of containers, regardless of material or color, enabling a powerful tool for ensuring the quality and security of food products. For example, ULF-MRI can be used to distinguish between spoiled and unspoiled foods or beverages without opening their containers.



The upper panels show brain images obtained ULF-MRI with acquired magnetic signals associated with brain function; the lower panels show a traditional MRI brain scan, which is not sensitive to brain function differentials.



ULF-MRI is capable of whole-body imaging; an image of human knees obtained with the ULF-MRI machine is shown here.

Most recently, LANL scientists working on ULF-MRI have been tasked with further developing the technology in response to a crucial national security need: the detection of potential threat substances at airport screening portals. LANL has developed a full-scale prototype, called MagViz, designed specifically for this application, which was tested successfully at the Albuquerque Sunport in December 2008. MagViz discriminates threat objects from benign materials using the same MRI contrast mechanisms used for brain imaging. MagViz is presently one of the only non-invasive techniques that can determine chemical composition in multiple unopened bottles, and through opaque and foil containers, allowing near-real-time screening of passenger luggage, especially liquids. MagViz is able not only to identify potential threat objects, but also determine the exact chemical composition of a liquid, enabling proper response and disposal of threats materials while minimally impacting current airport security screening methods.

LANL is currently seeking a commercialization partner(s) for the final development and deployment of the ULF-MRI technology across multiple industries. This technology is urgently needed to address homeland security concerns, and is currently being developed with the support of the Department of Homeland Security.

Development Stage: Prototype is operational, second generation prototype under development.

Patent Status: Strong intellectual property portfolio, please inquire for updated list.