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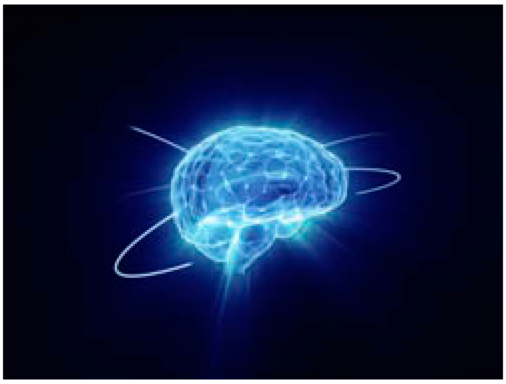
Hybrid MEG-MRI Imaging System

Results in Brief

A combinatorial method for improved brain imaging

By combining functional and structural imaging technologies, European scientists wished to improve the sensitivity and accuracy of brain imaging. Apart from neuroscience, the resultant hybrid scanner could be used in surgery and cancer diagnosis.

INDUSTRIAL TECHNOLOGIES



Magnetoencephalography (MEG) is a three-dimensional (3D) imaging technique that measures the magnetic fields generated by the neuronal signal transmission in the brain. This method can, therefore, map brain activity and generate functional images that could be utilised to study the cognitive and perceptual brain processes.

However, MEG does not offer any structural information, unlike magnetic resonance imaging (MRI) which provides visualisation of soft structures in the body, such as brain and muscle. Ultra-low field (ULF) MRI is a cost-effective alternative to traditional MRI, providing enhanced contrast and improved geometric accuracy of body tissues. Additionally, the low-intensity magnetic field makes the procedure suitable for pregnant women, children and patients with pacemakers.

The EU-funded 'Hybrid MEG-MRI imaging system' (MEGMRI) project wished to combine MEG and MRI technologies to develop a hybrid imaging scanner. This development would allow simultaneous structural and functional imaging of the human brain.

As a first step, the consortium set out to determine the most optimal sensor type for the hybrid scanner. To this end, partners optimised three different sensor types, low temperature and high temperature superconducting quantum interference devices (SQUIDs) as well as mixed sensors based on giant magnetoresistance (GMR). Three systems were produced, each with different sensors, geometry, coil system and electronics.

MEGMRI's final prototype scanner used an array of 72 sensors, significantly improving its performance compared with previously reported devices.

Applications for the project's hybrid scanner could include diagnostics prior to neurosurgery such as resection of tumors or epileptogenic cortex in patients with pharmacoresistant epilepsy. Providing enhanced functional and anatomical images would reduce the need for intraoperative recordings in the future.

Ultra-low-field MRI could also be exploited for cancer diagnosis. Improved anatomical accuracy in combined MEG and MRI studies may improve our understanding of the link between neuronal activity and behavioural performance.

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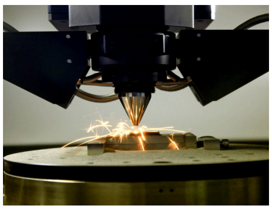

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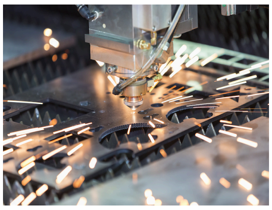

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MEGMRI

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