

Multi-channel system for combined transcranial focused ultrasound and magnetic resonance imaging

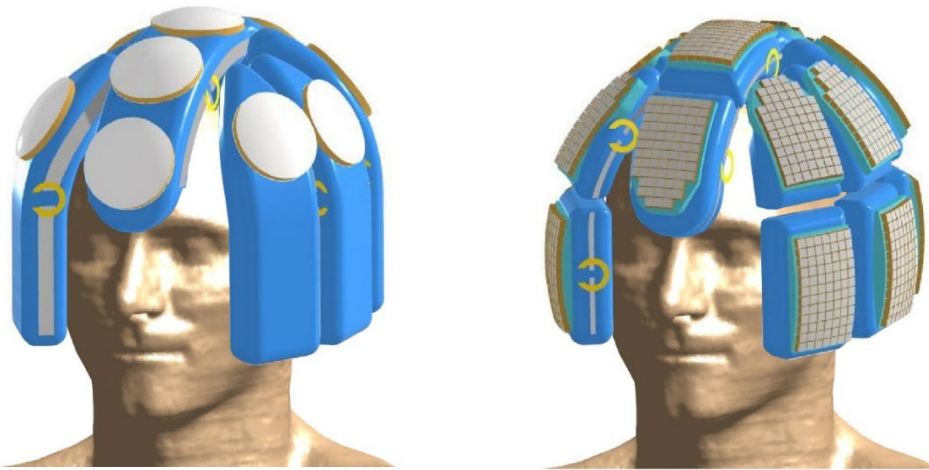


Figure: Two versions of the proposed invention: 16/16-channel (left) and 1024/32-channel arrays (right) for multi-focal ultrasound neuromodulation and whole-brain MRI. Each ultrasound transducer (or an ultrasound transducer array enabling beam steering) is placed on top, and each loop-dipole RF feed is placed on one side of the respective ultrasonic coupler (in blue) staying in direct contact with the head.

Ref. Nr

6.2425

Keywords

Focused ultrasound (FUS), Low-intensity focused ultrasound (LIFU), Ultrasound neuromodulation, Magnetic resonance imaging (MRI), Ultrahigh field (UHF), Multi-channel radio frequency (RF) arrays, MR-guided focused ultrasound (MRg-FUS)

Intellectual Property

EP 23170925.4, priority 01.05.2023

Date

23/01/2024

Description

The existing hardware approaches for multi-focal transcranial focused ultrasound (FUS) combined with magnetic resonance imaging (MRI) suffer from several limitations, and it is a challenging task to employ them at higher magnetic field strengths such as 7T.

This technology addresses the main weaknesses of the state-of-the-art technology for MR-guided FUS. This intrinsically complementary solution is based on using multiple, custom-designed, flexible structures which are not only used as ultrasonic couplers for ultrasound transducer arrays, but also act as a multi-channel, loop-dipole fed dielectric resonator antenna array for brain MRI at 7T (Figure).

Advantages

- High number of channels for both subsystems can be achieved: at least 1024 (FUS) and 32 (RF)
- Excellent performance of both subsystems for FUS and MRI
- MRI performance equal or higher vs. state-of-the-art solutions tailored specifically for 7T MRI
- Artifact-free brain MRI at 7T,
- No need for head shaving
- No need for invasive head fixation,
- Applicable for other body parts and magnetic field strengths

Applications

- MR-guided transcranial focused ultrasound neuromodulation, in particular using 7T MRI
- Other biomedical applications of focused ultrasound such as thermal ablation and blood-brain barrier opening for drug delivery