A device design intended to reduce sound emissions during transcranial magnetic stimulation (TMS)

Unmet Need

Transcranial magnetic stimulation (TMS) allows non-invasive stimulation of neurons in the brain using strong, brief magnetic pulses that induce electrical currents in neurons. TMS is widely used for probing brain function and it is an FDA approved treatment for depression, obsessive-compulsive disorder, smoking cessation, and migraine. A significant limitation of TMS, however, is that the magnetic pulse delivery is associated with an undesirable loud clicking sound reaching as high as 130 dB. The loud noise significantly impedes both basic research and clinical applications of TMS as it can interfere with accurate brain stimulation and can be potentially damaging to the patient’s hearing. There is a need for maintaining the increasing utility of TMS while minimizing the limitations associated with the loud coil click.

Technology

Duke inventors have reported a device design intended to reduce sound emissions during transcranial magnetic stimulation (TMS). Specifically, this is a new double containment coil with enhanced winding mounting (DCC), which utilizes acoustic impedance mismatch to contain and dissipate the impulsive sound within an air-tight outer casing. The coil winding is potted in a rigid block, which is mounted to the outer casing by its acoustic nodes that are subject to minimum vibration during the pulse. The rest of the winding block is isolated from the casing by an air gap, and sound is absorbed by foam within the casing. The casing thickness under the winding center is minimized to maximize the coil electric field output. A prototype has been developed in the lab.

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Publication(s)

External Link(s)

• From the lab of Brain Stimulation Engineering Lab at Duke

Other Applications

This technology suits both as a plug-and-play replacement to conventional TMS coils, or to be used in combination with other sound reduction techniques.

Advantages

- Offers acoustic noise reduction comparable to that provided by typical hearing protection devices
- Compared to commercial TMS coils, the Duke prototype has 14–37 dB lower noise at matched stimulation strength
- Provides 22% higher maximum stimulation strength than similar commercial coils
- Can enhance hearing safety and reduce auditory co-activations in the brain and other detrimental effects of TMS sound

Measured sound levels of various coils at a matched stimulation strength as a function of the maximum stimulation strength obtained at maximum stimulator output. Top: peak sound pressure level (SPL) at 167% average RMT at 5 cm from coil. Bottom: sound level (SL) of 20 Hz rTMS at 167% average RMT at 5 cm from coil.