Imaging current flow in the brain during transcranial electrical stimulation

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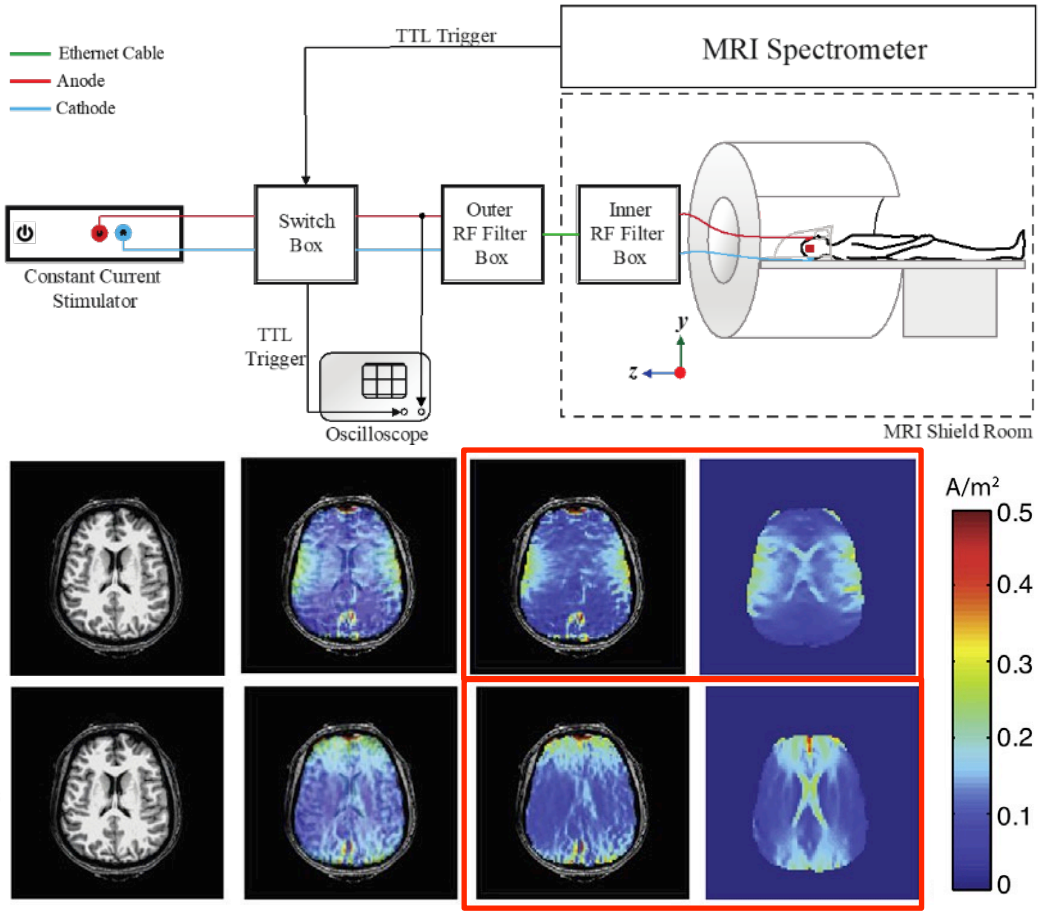
Transcranial electrical stimulation has been observed to improve cognitive, motor, and memory performance in healthy persons. Evidence suggests that it may also offer new treatments for stroke rehabilitation and epilepsy. However, the direct electrical current density distributions induced by transcranial electrical stimulation have not previously been measured in the brains of human subjects. As such, it has not been possible to directly correlate electrical current flow with how nerve activity changes with treatment.

This MagLab user collaboration used magnetic resonance electrical impedance tomography (MREIT) to measure magnetic flux density distributions caused by stimulated currents (see schematic). They then calculated current density distributions in the brain from these data. *Using this approach, they were able to present the first* in vivo *images of electric current density distributions within the brain of subjects undergoing transcranial electrical stimulation.*

In general, the new data from MREIT on living brains agreed with computational model predictions. MREIT can further be applied to improve reproducibility, to assess safety, and ultimately to aid our understanding of the mechanisms of electrical and magnetic neuro-modulation resulting from transcranial electrical stimulation.



Images show (left to right for two different stimulations) the standard MR image, measured electrical current distribution overlaid on MR image, measured electrical current density alone, and simulated current distribution. Note the similarity between the third and fourth images (red boxes).
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Facility: 3 T MRI system in the AMRIS Facility at UF

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