Combined TMS/MRI with deep brain stimulation capability

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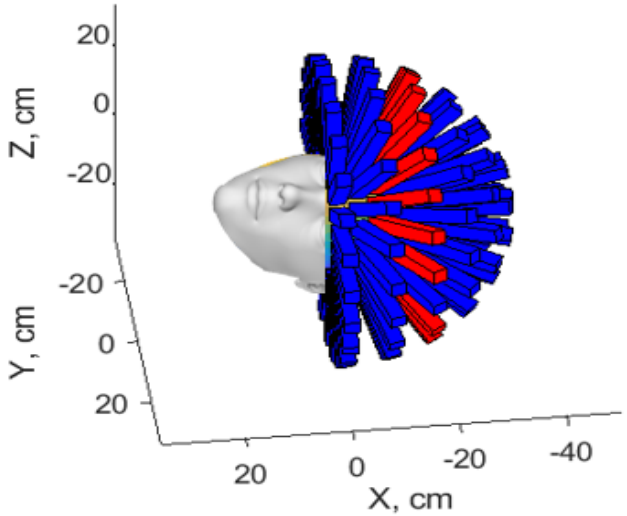

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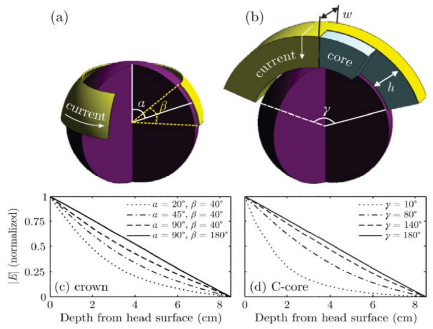
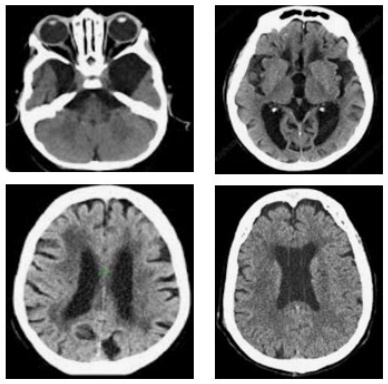
Transcranial Magnetic Stimulation (TMS) Limits

Can’t reach the deep brain safely





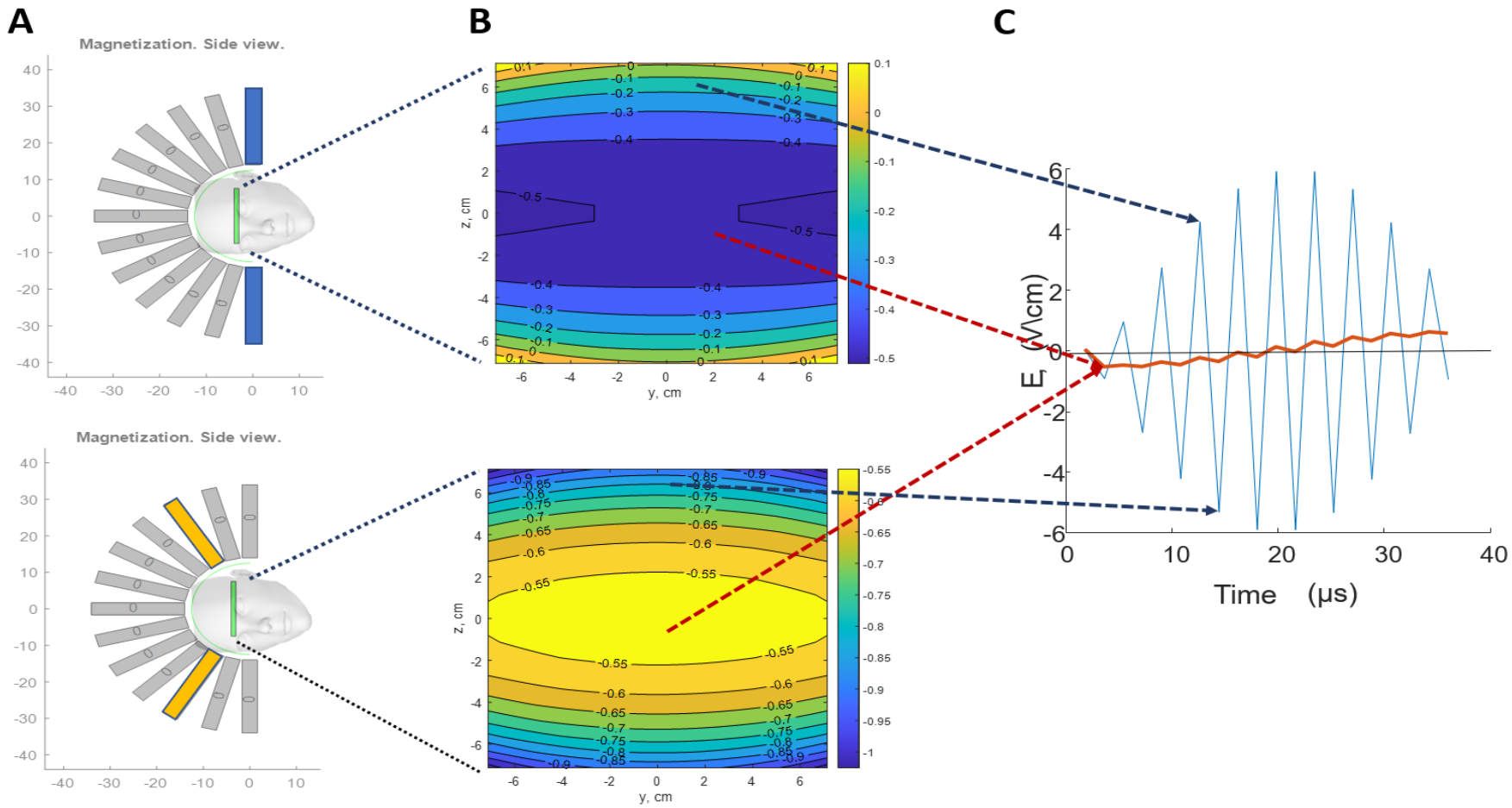
- Deep brain (e.g., amygdala) responsible for pain, fear, …
- Surface based TMS is 10x weaker in deep brain[1]
- TMS does not take anatomic variation into account[2]
- As a result, TMS not so good at treating pain, fear, etc.

[1] Z-D Deng, S.H. Linsanby, A.V. Peterchev. Clin. Neurophysiol. 2014 125(6):1202-1212

[2] F Syeda et al. AIP Advances 7(5) (2017)

Proposed solution: Tomographic image-guided TMS

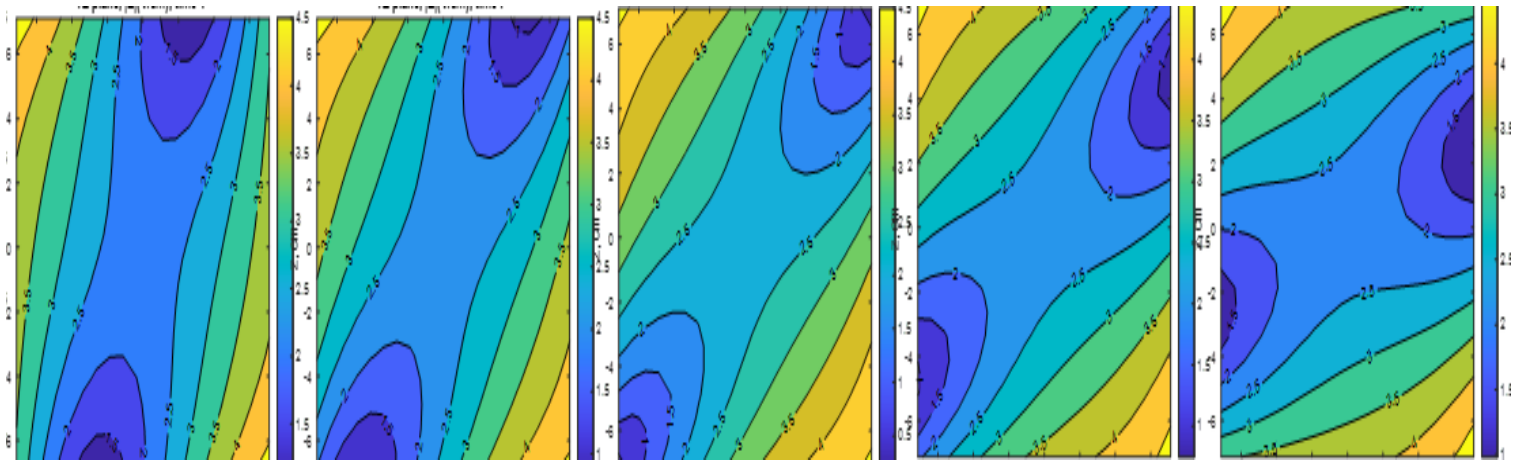
Sum fields in phase (as in x-ray CT)



101 electropermanent magnets around head apply pulsed magnetic fields for MRI and stimulation. Superficial tissues see high frequency fields (too fast for bio-effects), while deep tissues see slow fields

Multifocal delivery for brain circuit modulation

Each electropermanent magnet controlled with 10 ns timing



Rotating fields can stimulate multiple foci simultaneously or in phase. Can modulate entire circuits anywhere in the brain