Impact of Phase-Lags and Electrode Montages on Electric Fields of Dual-Site tACS Targeting the Motor Cortices: A Simulation Study

Contact

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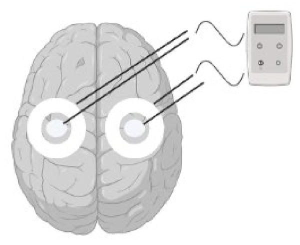
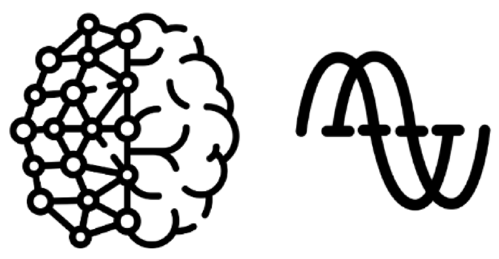
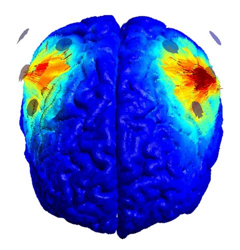
Introduction



Dual-site tACS



Modulate functional connectivity between regions with phase-lag

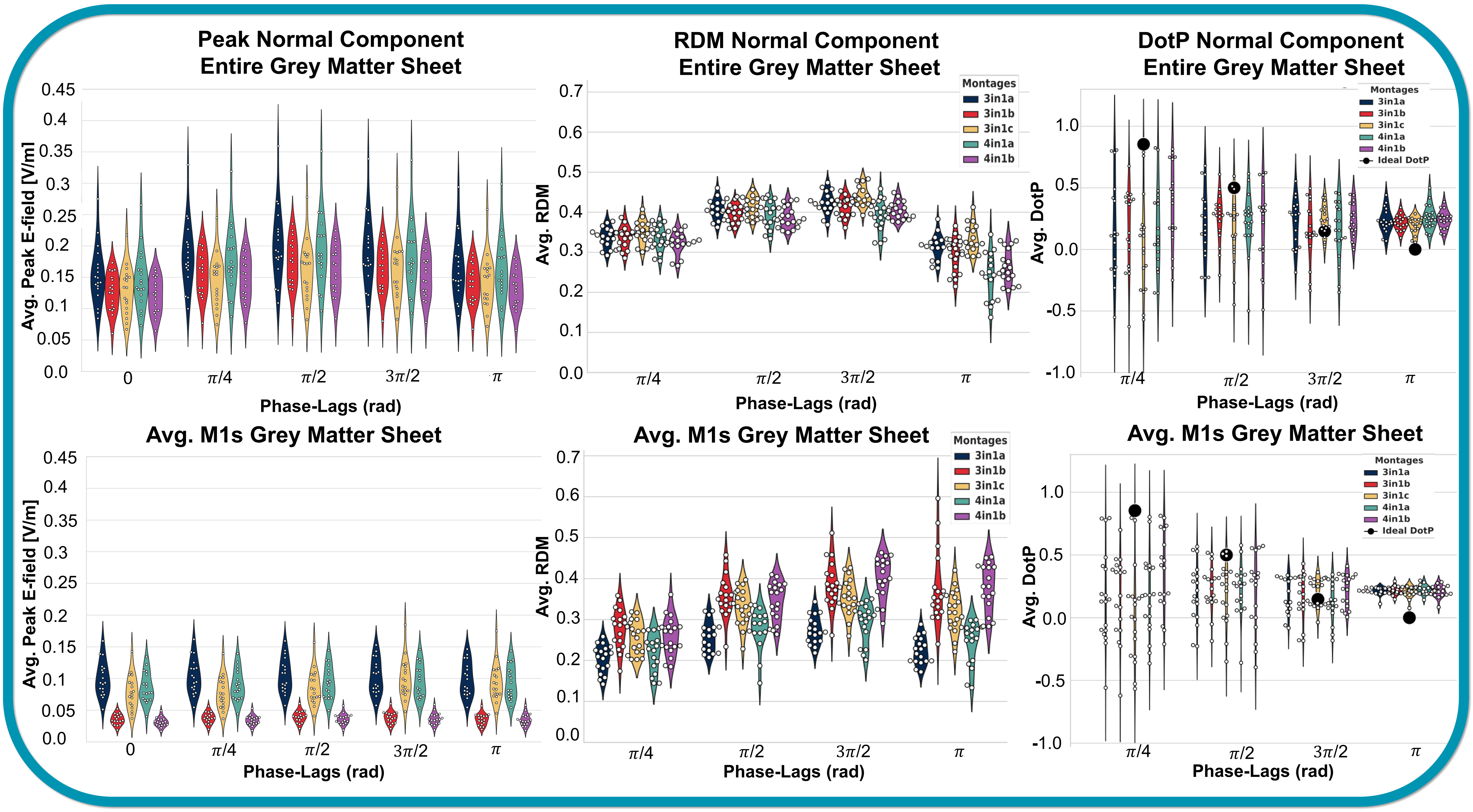


Primary Motor Cortices (M1s)

Aims

Determine whether the effects of phase-lag variations and different stimulation montages can be isolated without altering other E-field parameters, laying the groundwork for future direct comparisons of different phase-lags on functional brain connectivity

Results

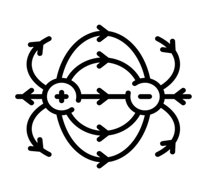


Methods

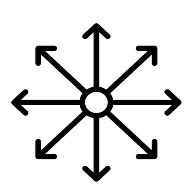
Simulations

- 18 MRIs from the Human Connectome Project
- 25 tDCS simulations (SimNIBS) per MRI, to obtain tACS
- Maximum current of stimulation: 4mA peak-to-peak
- Simulated 5 phase-lags: $0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi$
- Simulated 5 multi-individual electrodes montages

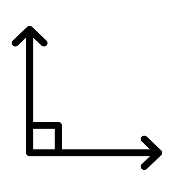
Metrics



Peak normal component



Distribution (RDM) normal component



Orthogonality (DotP) normal component

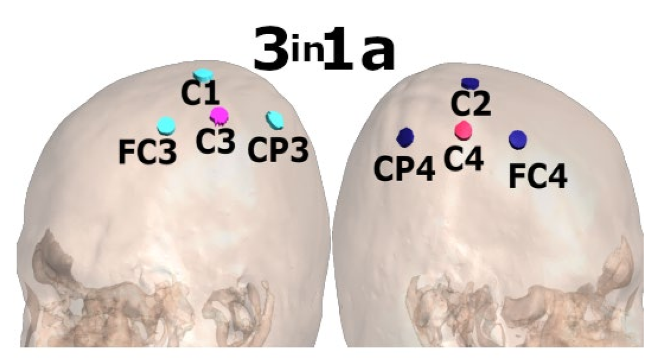
$$\text{RDM} = \left\| \frac{|E_n^{in}|}{\|E_n^{in}\|} - \frac{|E_n^{\phi}|}{\|E_n^{\phi}\|} \right\|$$

$$\text{DotP} = \frac{E_n^{in} \cdot E_n^{\phi}}{\|E_n^{in}\| \|E_n^{\phi}\|}$$

E = normal component
ϕ = phase-lag ≠ 0
in = 0 phase-lag
n = # triangles mesh

Conclusions

- Measures of peak normal component, RDM, and DotP are influenced by the **phase-lag** on the entire grey matter sheet.
- **Montage 3in1a** has the highest values of peak normal component, and the lowest values of RDM and variability between participants.



- Phase-lags other than 0 and π result in variations in amplitude, distribution, and orthogonality of the E-Fields, **indicating that phase-lag changes affect multiple E-field parameters.**

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