Focal transcranial electrical stimulation on a realistic head model via temporal interference

Kyle J. Curham & John J. B. Allen
Department of Psychology - University of Arizona - Tucson, Arizona

Introduction

- Transcranial electrical stimulation (TES) has limited spatial resolution and induces a large stimulation artifact that obscures EEG.
- Temporal interference stimulation (TIS) overcomes these limitations by stimulating at high frequency (>1 kHz).
- Interference between waveforms (e.g., 1 + 1.005 kHz) results in an amplitude-modulated signal at the difference frequency (5 Hz)
- Artifacts can be removed with a simple low pass filter.

Phantom Construction

- 3-d printed (ABS-CB) conductive skull
- Gyroid infill to mimic mass transport, conductivity, and density of trabecular bone layer
- Agar gel brain
- 3-d printed (PLA) brain formed a positive mold.
- RTV silicone was poured over the positive mold to form the negative mold.
- Near-boiling saline-dosed agar was poured into the negative mold and allowed to harden.

Phantom Brain Construction

3-d printed PLA brain
Agar mold
Agar Brain

Phantom Skull Construction

3-d printed ABS-CB skull
Liquid Latex Application
Complete skull & brain

TIS Results

TIS Mean Power
TIS Spectrum

TACS Results

TACS Mean Power
TACS High Spectrum

TACS Low Spectrum

Results

- TIS (1+1.005 kHz) was compared to 5 Hz TES on a Phantom head model.
- As expected, there was a prominent 5 Hz peak in the power spectrum for both TIS and TES.
- but TIS exhibited a more central scalp topography.

References

[For a complete list of references, see the original document.]