Transcranial Current Stimulation (tCS)

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tCS devices
The battery is the core and the control unit of Starstim. It is a battery operated and it is wirelessly paired with the computer using the Nic software. 4-pin slot to connect with the electrode cable.

The 4 electrode cable contains 32 channels for EEG monitoring or for stimulation, and two reference channels labelled with CMS & DRL.

The neoprene cap is a comfortable solution to precisely place the electrodes on the scalp based on the 10-10 system.
1. Reference electrodes
2. Place cap
3. Reduce impedance
4. Place electrodes
➢ Clean the hard bone behind the ear (Mastoid) with an alcohol wipe;

➢ Place ground electrodes with sticky electrodes (ECG Electrodes) on Mastoid; CMS on top (horizontal, directly on bone), DRL on bottom (vertical, behind ear lobe);
➢ Ensure that cap has channel gauges pre-placed in all channels before-hand (based on subject specific stimulation montage);

➢ Place cap on head of subject;

➢ Measure mid-way between the nasion & inion and left tragus & right tragus, and make sure midpoint of skull lines up with CZ channel
➢ Use cotton-tipped swab and Nu-Prep; clean scalp and push away hair using an up-down at each electrode location, left-right motion (making a cross); do not use a circular motion to clean the scalp with Nu-Prep.

➢ Squeeze signa gel in each electrode channel; fill up ¼ of channel gauge capacity, make sure gel is in direct contact with scalp.
➢ Twist on electrode onto channel gauges; make sure to twist electrode on so that it is level and tight; Note: the electrodes do not click or lock into place, make sure they are secure

➢ Box is attached to the neoprene cap using the velcro, and it is connected to the electrode cable using the 10-pin connector.
Parameters for stimulation

**Where to stimulate?**
Determine **target site & device position/orientation** for stimulation based on...
- functional localizer
- source localization
- individual gyral anatomy
- local strength of electric field
- local direction of current flow

**When to stimulate?**
Determine **target onset/time window** relative to task or spontaneous event for stimulation based on...
- induced power
- latency of evoked responses
- oscillatory power

**How to stimulate?**
Determine specific parameters for stimulation such as...
- stimulation intensity
- stimulation frequency
- pulse/wave form
- polarity

occurrence of specific events
Parameters for stimulation

fMRI activation map

tCS solution with 2 electrodes

Multifocal tCS solution with 8 electrodes
tACS and Phase Coupling: Working Memory

Fronto-parietal Phase-lag

Band-pass 6 +/- 1 Hz

0° phase difference

180° phase difference

PLEASE DO NOT COPY
What is frequency sensitivity of tACS evoked Visual Sensation?

**Rationale**

Eye Open/Closed Alpha (Adrian, 1934)

**Design**

<table>
<thead>
<tr>
<th>Electrodes</th>
<th>Inion (+4cm) - Vertex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>0-40Hz, 0-1mA, 5s each</td>
</tr>
<tr>
<td>Subjects</td>
<td>8 Healthy</td>
</tr>
</tbody>
</table>
tACS and Phosphene

Results

- Occipital tACS can evoke phosphene perception
- Efficiency of stimulation is maximal at alpha band (dark) and beta band (light)

But...is it a cortical phenomenon?

(Schwiedrzik, 2009), (Schutter, 2010); (Paulus, 2010).
Thank you for your attention

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