neurocare

Focal tES using neuroConn DC-STIMULATOR

Transcranial Electrical Stimulation

Transcranial Electrical Stimulation (tES) is a non-invasive technique which uses low currents and is applied to modulate cortical excitability. A well-known limitation of tES, as commonly used, is its poor stimulation focality. The application of two electrodes, one over the target area ("target" electrode) and one over the distant site (return electrode), induces spreads of current over an extensive portion of the brain affecting not only the area under both electrodes but also the areas between them [1].

The lack of focality and the stimulation of the cortex under the return electrode associated with the standard bipolar montage has been addressed by so-called high-definition HD-tES, in which the active electrode is surrounded by several return electrodes. However, HD-tES requires the use of a dedicated adaptor to distribute the current equally among the return electrodes.

Concentric Ring tES

A novel alternative version of the HD-tES montage, the Concentric Ring tES, has been implemented by [1, 2, 3, 4] using two concentric electrodes with predefined diameters that can be used with a standard tES device (one anode and one cathode). Depending on the dimensions and tES parameters, the current density on the skin and gray matter surface will be varied (see back).

Advantages of Concentric Ring Stimulation:

Recent studies have confirmed that the novel Concentric Ring set-up:

- is safe, tolerable and with blinding efficacy in and outside the MR scanner [2],
- has only mild adverse affects, which are less pronounced in comparison to HD-tES [2],
- enables more focal stimulation of the target area, compared to classic montages,
- significantly reduces neurosensory side effects, which is essential for placebo-controlled study designs [3].

Electrode setup of novel concentric ring tES approach with ring electrode (A) and central round electrode (B)

Literature:

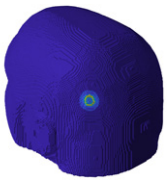
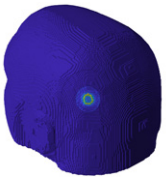
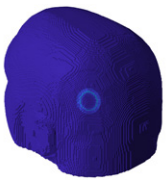
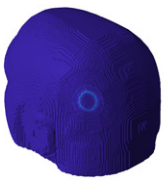
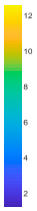
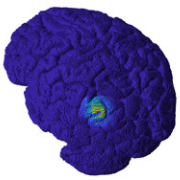
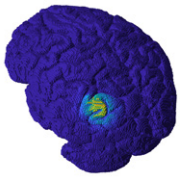
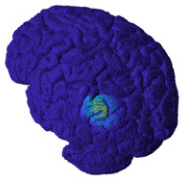
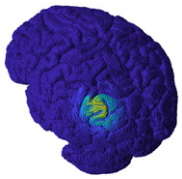
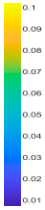
[1] Bortoletto et al., 2016. Reduced Current Spread by Concentric Electrodes in Transcranial Electrical Stimulation (tES). Brain Stimulation. doi: 10.1016/j.brs.2016.03.001

[2] Gbadeyan et al., 2016. Safety, Tolerability, Blinding Efficacy and Behavioural Effects of a Novel MRI-Compatible, High-Definition tDCS Set-Up. Brain Stimulation. doi: 10.1016/j.brs.2016.03.018

[3] Heise et al., 2016. Evaluation of a Modified High-Definition Electrode Montage for Transcrancial Alternating Current Stimulation (tACS) of Pre-Central Areas. Brain Stimulation. doi: 10.1016/j.brs. 2016.04.009

[4] Martin et al., 2017, Causal evidence for task-specific involvement of the dorsomedial prefrontal cortex in human cognition. Soc Sogn Affect Neurosci. doi: 10.1093/scan/nsx063

Current modelling with Concentric Ring tES*

	center diam. 10 mm ring inner diam. 24 mm outer diam. 48 mm	center diam. 10 mm ring inner diam. 30 mm outer diam. 70 mm	center diam. 20 mm ring inner diam. 30 mm outer diam. 75 mm	center diam. 20 mm ring inner diam. 40 mm outer diam. 75 mm	
model geometry					 Anode Cathode
Current density skin surface					 Current density in A/m²
current density gray matter surface					 current density in A/m²

* Models were created by M.Sc. Alexander Hunold, Technical University Ilmenau, Germany

Range of neuroConn concentric ring electrodes

neuroConn offers a wide range of geometric as well as customized sizes (pair wise):

Center electrodes:

305090-01	Rubber electrodes, circular	dia: ca. 10 mm	(area: ca. 0,8 cm²)	without hole
305090-02	Rubber electrodes, circular	dia: ca. 20 mm	(area: ca. 3 cm²)	without hole
305090-03	Rubber electrodes, circular	dia: ca. 34 mm	(area: ca. 9 cm²)	without hole

Ring electrodes:

305090-07	Rubber electrodes, circular	dia: out 75/in 20 mm	(area: ca. 41 cm²)
305090-08	Rubber electrodes, circular	dia: out ca. 100 mm/in ca. 75 mm	(area: ca. 40 cm²)
305090-12	Rubber electrodes, circular	dia: out ca. 48 mm/in ca. 24 mm	(area: ca. 15 cm²)
305090-13	Rubber electrodes, circular	dia: out ca. 110 mm/in ca. 90 mm	(area: ca. 31 cm²)
305090-15	Rubber electrodes, circular	dia: out ca. 75 mm/in ca. 30 mm	(area: ca. 37 cm²)
305090-16	Rubber electrodes, circular	dia: out ca. 100 mm/in ca. 70 mm	(area: ca. 40 cm²)
305090-17	Rubber electrodes, circular	dia: out ca. 45 mm/in ca. 15 mm	(area: ca. 14 cm²)

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