

Simultaneous EEG with non-invasive brain stimulation (NIBS)

Globally unique solutions for neuroscience research

Combining non-invasive brain stimulation with neuroimaging

Simultaneous recording of DC-EEG during non-invasive brain stimulation (NIBS), such as transcranial Direct Current Stimulation (tDCS), transcranial Alternating Current Stimulation (tACS, tRNS) or transcranial Magnetic Stimulation (TMS) is a painless method to evaluate the modulation of cortical oscillatory brain activity and cerebral plasticity. These methodologies allow neuroscientists to investigate a broad range of research topics, such as:

- establishing a causal link between brain functions and behavior
- understanding the online mechanisms of brain stimulation
- assessing how non-invasive brain stimulation locally affects neural processing by means of objective measures of cortical activity, reactivity and connectivity
- determining in vivo the brain areas directly or indirectly affected by non-invasive brain stimulation
- improving stimulation protocols based on direct effects to brain activity

neuroConn integrates full-band DC-EEG recording with NIBS technologies offering globally unique and highly sophisticated solutions for researchers.



neuroConn full-band-DC-EEG device NEURO PRAX® TMS/tES

neuroConn technology fulfills all technical requirements for the following combined applications:

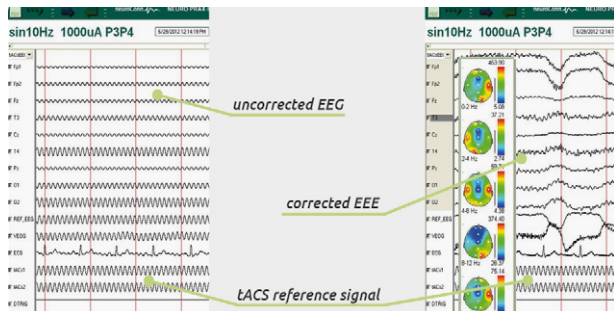
- noise free DC-EEG during **tDCS/tACS/tRNS**
- noise-free DC-EEG during (navigated) **TMS**
- noise-free DC-EEG during **fMRI**

Researchers and clinical users also require further detailed understanding and expertise in the methodical aspects of these applications in order to:

- avoid amplifier saturation
- reduce induced current into electrodes and cables
- prepare the skin properly
- interpret the artefacts and their elimination

Please refer to the neurocare academy section (over-leaf) for more information regarding training and education.

Combining EEG with NIBS in Neuroscience research



A globally unique solution for neuroscientists: The DC-**STIMULATOR PLUS** combined with the **NEURO PRAX®** TMS/tES provide artifact-free EEG-tACS.

Noise-free EEG during tES: a globally unique solution by neuroConn

Why combine EEG with tES (tDCS, tACS, tRNS)?

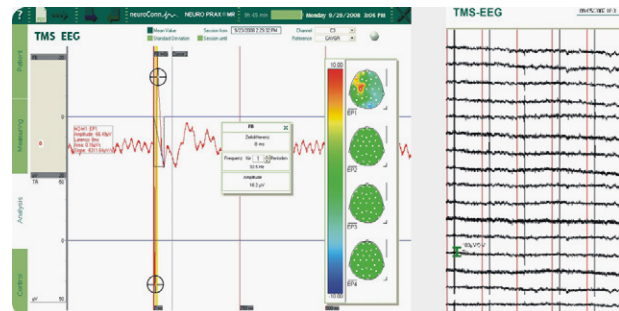
- tES-EEG for functional neuroimaging in science and clinic
- detailed understanding of tES-induced effects in motor and non-motor regions
- detailed understanding of local and network effects of tES
- discover brain-behavior relationships
- guiding tES input parameters by monitoring brain states

The neuroConn DC-**STIMULATOR PLUS** and **NEURO PRAX®** TMS/tES work hand in hand to provide noise-free EEG while stimulating the brain with tDCS and even with tACS. The DC-**STIMULATOR PLUS** delivers a galvanically isolated reference signal of the applied stimulation, whilst **NEURO PRAX®** eliminates the stimulation-induced artefacts from all EEG channels in real time using an innovative correction software. The high dynamic range of 219 mV allows for a recording of brain signals during tES without saturation of the EEG.

Relevant scientific references demonstrating the methods of combining EEG with NIBS:

- EEG-NIBS: Bergmann T. O. et al., *NeuroImage*, 2016;
- Thut G. et al., *Clin Neurophysiol.*, 2017
- EEG-tACS: Schlegelmilch F. et al., *Clin Neurophysiol.*, 2013; Helfrich R. F. et al., *Curr Biol.*, 2014
- TMS-EEG: Rogasch, N. C. et al., *Hum Brain Mapp*, 2013; Herring J. D. et al., *J Neuroscience*, 2015; Mäki H. et al., *NeuroImage*, 2011

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NEURO PRAX® TMS/tES: short recovery times of 3-5 ms after the TMS pulse allow correction of TMS-induced artefacts in realtime for all channels.

Simultaneous EEG with TMS in combination with neuronavigation

Why combine EEG with TMS?

- TMS-EEG for functional neuroimaging
- better insights into cortico-cortical and interhemispheric interactions
- more direct assessment of cortical inhibitory processes
- deeper understanding of cortical plasticity
- prospects of clinical applications

Furthermore, **NEURO PRAX®** integrates with **Brain-sight TMS Navigation** and **Brainsight NIRS** by Rogue Research for navigated EEG-TMS. This setup ensures the accuracy of coil placement and constant coil location over several sessions or in multiple sessions in TMS experiments.



Empowering best practice

Through our global network of scientists, clinicians and engineers, we offer online theoretical courses which can be followed up by a practical training day onsite at neurocare, or by arrangement with your practice or institution.

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Courses for scientists offer in-depth knowledge on the scientific application of neuromodulation and its combinations with neuroimaging techniques, e. g. multichannel tES, EEG-TMS, EEG-tDCS, EEG-tACS and navigated TMS. Furthermore, our experts provide technical supervision for your research and support you with their methodical expertise.