

Brain Products Cooperations

Combining EEG with NIRS

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What is NIRS?

Near Infrared Spectroscopy (NIRS) is a functional imaging technique that employs low-energy optical radiation (mostly at 2-3 wavelengths) to assess absorption changes in the underlying brain tissue. These absorption changes reflect changes in the local concentration of oxy- and deoxy-haemoglobin, which in turn are related to and triggered by the alteration of neural activity. That is, NIRS is a non-invasive imaging tool and utilizes endogenous chromophores to assess the brain's functional activity.

Why combine EEG and NIRS?

EEG and NIRS are sensitive to different cascades of events that are linked to the same neural activities. In addition, both these modalities possess complementary temporal and spatial features. The combination of EEG and fNIRS therefore offers the possibility to examine the brain's functional activity more comprehensively. Even though fMRI is superior to fNIRS in terms of spatial resolution, spatial coverage, and the ability to address questions related to deeper brain areas, it has the big disadvantage of immobility. Furthermore, an MRI scanner is typically much more expensive than a NIRS system.

Especially the fact that a NIRS device is much more compact and possibly even mobile makes it a good companion for the EEG. A number of scientific applications can benefit from the simultaneous co-registration of EEG and NIRS signals. BCI is one of the research fields where this combination is becoming more and more popular. In this case, for example, the NIRS signal can be used as a predictor for EEG-based BCI performance.

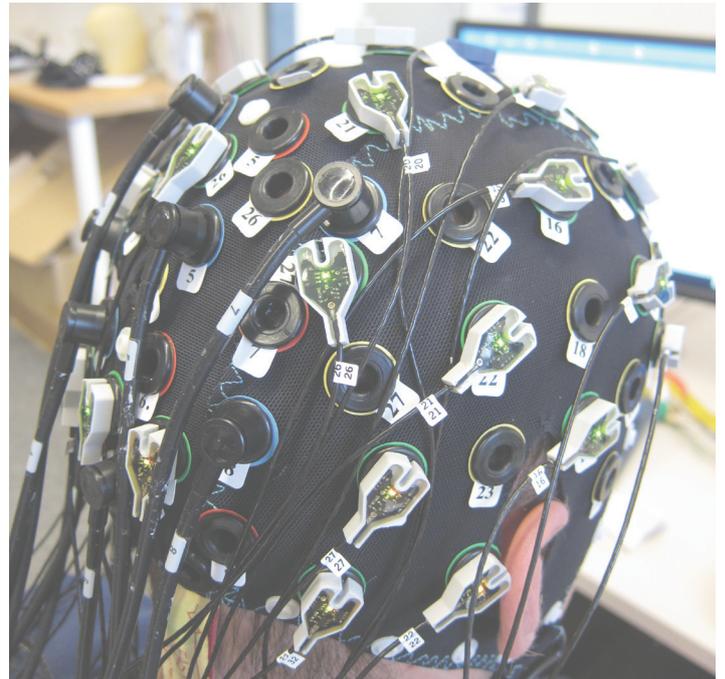
Using Brain Products equipment for EEG/NIRS co-registration

Technically, the combination of the Brain Products EEG equipment and an NIRS system is quite easy. The majority of commercially available NIRS systems do not interfere with the EEG signal at all or induce artifacts. Because of that, all our EEG amplifiers can be used for simultaneous EEG-fNIRS measurements. Nevertheless, in combining these techniques, two aspects need to be considered carefully: sensor/electrode placement and data stream synchronization.

Sensor/electrode placement

Brain Products and EasyCap offer special caps for the EEG/fNIRS co-registration. They are made of black fabric in order to decrease unwanted optical reflection. They have EEG electrode holders that provide a perfect platform to accommodate both NIRS optodes and EEG electrodes. They come with separate electrodes. This flexible setup can be used to realize several electrode-optode-configurations.

The NIRS and EEG sensors can either be placed in the same position or alternately. The former is certainly more challenging, and is used most frequently where the area of interest is limited, for example during baby measurements.



The joint placement is possible only if ring EEG electrodes and transparent gel is used and the NIRS optode is small enough to fit into the slit of the electrode. Our caps can be used with both application scenarios.

Data stream synchronization

During the combined measurement, the EEG and NIRS systems work independently, therefore the same time point has to be marked in both data streams. This is typically done by sending the same marker signal (TTL triggers) to the EEG and to the NIRS system. The hardware based TTL triggers offer the highest possible precision. These shared markers make it possible to identify and analyze the recordings acquired at exactly the same time. Brain Products offers a standard trigger cable with every amplifier system which works with most commercially available NIRS systems. Customized solutions are also available.

As Brain Products equipment is widely used for EEG/NIRS co-registration with a large number of commercially available NIRS devices, we invite you to contact us at: sales@brainproducts.com for any general question about this methodology or, more specifically, about the way our systems interface with your particular NIRS devices. ●