

STSM REPORT

COST STSM Reference Number: COST-STSM-BM1205-20196

STSM Grantee: Vesa Korhonen

STSM title: Test trials to verify response of a NIRS device designed to study skin cancer

Home Institution: University of Oulu

Host Institution: Leibniz Institute for Neurobiology

STSM period: 24.05.2014 – 31.05.2014

STSM purpose: Conducting comparison measurements with a commercial NIRS device to ensure and verify the basic function and response of the developed NIRS device.

Description of the work carried out during the STSM:

During the STSM comparison measurements were done using simultaneously both our own developed NIRS device and a commercial NIRS device, Hitachi ETG-4000 in Clinical Affective Neuroimaging Laboratory, Leibniz Institute for Neurobiology, Magdeburg. Our own device uses wavelengths of 660 nm, 830 nm and 940 nm for illumination whereas ETG-4000 uses only two wavelengths of 695 nm and 830 nm. ETG-4000's sync signal provided the exact synchronization between devices which made comparison possible.

Using the setup we measured noninvasively healthy skin from stomach, a mole with size of approximately 10 mm² from stomach and also skin/brain signal from forehead because ETG-4000 has been developed to measure especially from the brain. In this report I introduce signals measured from the brain simultaneously with both devices and my colleague Teemu Myllylä show signals measured from the skin, particularly a mole in his STSM report.

In brain measurements one channel of our device was placed to the forehead and ETG-4000's several channels were used. One of those channels was quite near of our device's channel and those signals are compared. The distance between a transmitter optode and a receiver optode was always 3 cm in both devices and that is the distance what is usually used in NIRS brain measurements. Recorded data is used for further correlation analysis between the devices.

During the STSM we were able to make also MEG and MRI compatibility measurements with our NIRS device in The Clinical Affective Neuroimaging Laboratory. Above mentioned simultaneous measurements with both MEG and NIRS and fMRI and NIRS may provide interesting possibilities for skin cancer studies and cancer studies in general.

Description of the main results obtained:

Raw NIRS signals measured from forehead simultaneously with both devices in 20 minutes resting state measurement showed similarities in response (figure 1). However, there were also differences in signals which may result from differences in signal processing between the devices, different measuring place, use of different sampling rates and also different wavelengths.

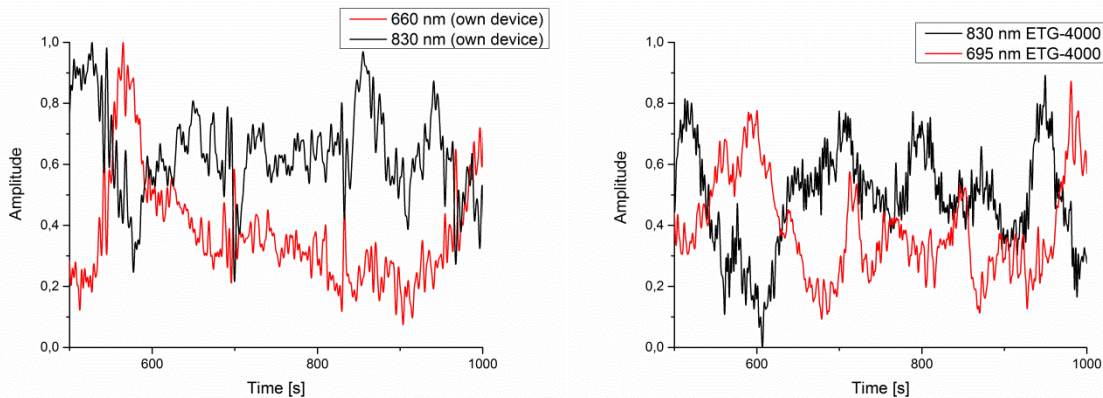


Fig. 1. Raw NIRS signals measured from forehead simultaneously with both devices. Signals got from own developed NIRS device (left) and from Hitachi ETG-4000 (right).

Based on the measurements of the brain, it seems that both devices can sense similarly blood oxygen depend dynamics in the brain at low frequencies, below 0.5 Hz, as shown in Figure 2. However, response of ETG-4000 shows fewer amounts of peaks above frequencies of approximately 0.1 Hz, but on the other hand more peaks are visible at lower frequencies. The reason for that again might be the signal processing of the commercial device, which is optimized for lower frequencies. Also the measurement place was little bit different.

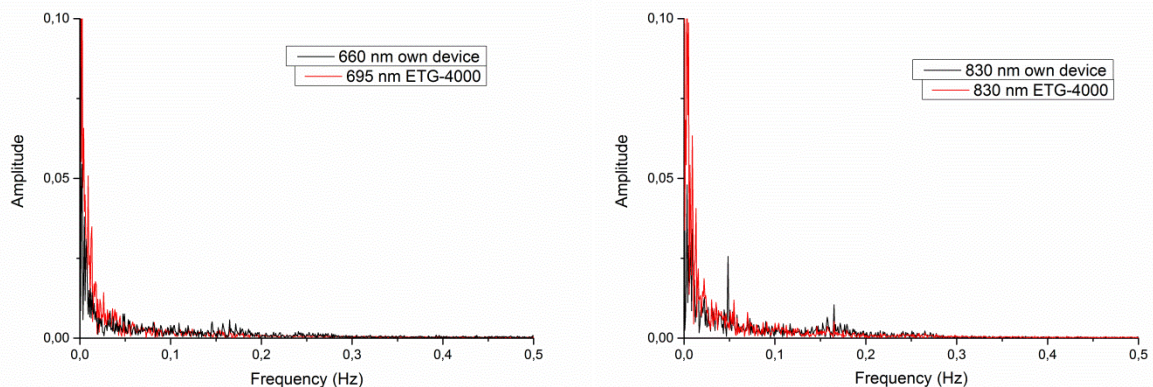


Fig. 2. Amplitude spectrums of the measured NIRS signals from both devices. Signals were recorded from the forehead and both amplitude spectrums are showed; red (left) and infra-red (right). Measurement was done in resting state and the measurement time was 20 minutes.

As already mentioned, especially Hitachi ETG-4000 is intended to be used in brain studies, where mainly low frequency fluctuations are of interest. Probably, raw data recorded by the device, is thereby band pass filtered at 0.001 Hz – 0.5 Hz, thus limiting wider comparison analysis between the devices. Therefore, we were not able to compare dynamics at higher frequencies. Moreover, illumination power used in the device is high and optimized for a source-detector distance of 3 cm. For that reason lowering the distance would have caused saturation of the measured signal. Despite of these limitations in comparison measurements, our main goal was to ensure basic response of our

NIRS device, which could be accomplished with ETG-4000. Based on our test measurements, we may conclude that our own developed device can sense similarly tissue oxygen changes as the commercial NIRS device. Furthermore, the device showed to be MRI and MEG compatible.

Mutual benefits for the Home and Host institutions: Cooperation between the laboratories, increase of knowledge in tissue metabolism studies. The COST mission has also shown that there are possibilities to start joint multimodal measurements in wide range of different study cases, related to tissue metabolism.

Future collaboration with the Host institution (if applicable): There are joint interests in research. Further discussion of using multimodal measurements in different study case studies will be continued already in OHBM 2014 in Hamburg.

Foreseen journal publications or conference presentations expected to result from the STSM (if applicable): Not sure yet. More signal analysis has to be still done.

STSM outcome form

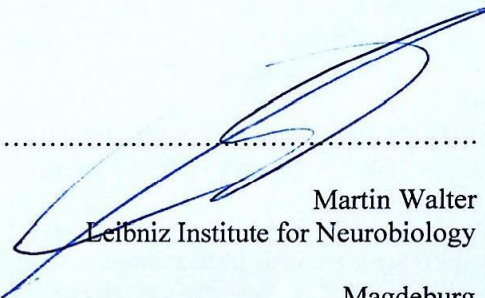
STSM application number	Home institution & country	Host institution & country	BM1205 WG	Objective of the collaboration	Results of the collaboration
COST-STSM-BM1205-20196	University of Oulu, FINLAND	Leibniz Institute for Neurobiology, GERMANY	WG 4	Test trials to verify response of own developed near-infrared spectroscopy (NIRS) device.	Response of the own NIRS device was successfully compared to Hitachi ETG-4000. Additionally, MRI and MEG compatibility was studied.

Confirmation

Herewith I would like to confirm the completion of the STSM applied by Vesa Korhonen.

He worked in this project from 24st to 31th of May 2014 and fulfilled the objectives of the STSM work plan in Leibniz Institute for Neurobiology.

The purpose of the STSM was to test and verify response of the developed NIRS device by conducting comparison measurements with Hitachi ETG-4000.



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Martin Walter
Leibniz Institute for Neurobiology

Magdeburg
Germany