2021 IEEE 18th International Symposium on Biomedical Imaging (ISBI)
April 13-16, 2021, Nice, France

EXPLORING THE CEREBELLUM WITH FUNCTIONAL NEAR-INFRARED IMAGING: A PRELIMINARY STUDY

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This study details the possibility to use functional Near-Infrared Spectroscopy (fNIRS) as a novel technique to unravel the cerebellar role in motor and cognitive processes. A simple motor task highlighted differences in the cerebellar hemodynamics between baseline and experimental session due to the subject's engagement.

1. INTRODUCTION

Over the recent years, besides its well-known role in motion control and smoothness, the cerebellum has proved to be involved also in emotion and cognition. The underlying mechanisms are still unclear, because the cerebellum is not easy to access and shielded by muscles. Despite a sub-optimal temporal resolution, functional Magnetic Resonance Imaging (fMRI) has been so far the golden standard to study the functional aspects of the cerebellum. However, a higher time resolution is needed to compare activation latencies of the cerebellum (~10 ms [1]) to other brain structures. This study evaluates the feasibility to use a low-cost and non-invasive alternative to functionally explore the cerebellum, i.e. functional Near-Infrared Spectroscopy (fNIRS), by measuring changes in concentration of oxygenated (HbO_2) and deoxygenated (HbR) hemoglobin caused by neuronal activation in the tissue underneath.

2. METHODS

One subject was recruited for the experiment and asked to comfortably sit on a chair in a dark room[†]. First, a 5-minutes baseline recording was done. Then, a 6-minutes task session followed with two repetitions: 120-second rest periods were separated by a finger tapping. The data were acquired with the Artinis Oxymon system, setting the wavelengths at 763 and 858 nm, and the sampling rate at 50 Hz. One channel was acquired in each cerebellar hemisphere. The optodes placement was inspired by [1] where two reference positions, namely CB1 and CB2, were added to the conventional EEG 10/20 system. After proper assessment of the adequate neurovascular coupling between the optodes and the scalp, the measured light intensities were converted to changes in concentration (ΔHbO_2 and ΔHbR). A band-pass FIR filter with cut-off frequencies 0.01 – 0.07 Hz was applied [2].

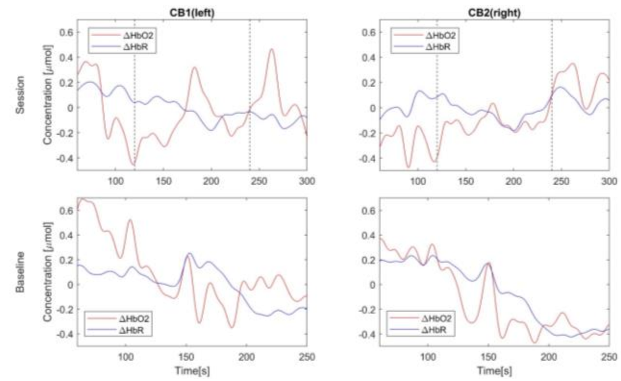

Fig. 1. fNIRS filtered signals measured during the task session (top) and the baseline (bottom) for CB1 and CB2.

3. RESULTS AND CONCLUSIONS

In Fig. 1, if the baseline condition shows a marked decrease of ΔHbO_2 and ΔHbR, the experimental session exhibits a linear increase of ΔHbO_2: two peaks of ΔHbO_2 about 30 and 60 s after the finger tapping phases (dashed lines) are visible. Also, two local minima after the ΔHbO2 peaks, can be seen on the ΔHbR signal. Such hemodynamic changes appear correlated to the subject's engagement in the task, thus reasonably stimulus-induced [2]. These preliminary results are promising and pioneering a novel way of exploring the cerebellum, suggesting differences in its hemodynamic behavior compared to the brain. Thus, extended analyses in this direction are encouraged.

4. REFERENCES

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*Funded by Horizon 2020 COFUND "BoostUrCareer" no. 847581. The authors declare that there is no conflict of interest.
†Approval for this study was granted by CERNI.