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Distinguishing foveal and peripheral vision from brain activity using fNIRS

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Introduction: Vision plays a crucial role in exploring our surroundings. It helps us to avoid dangerous situations and to respond to changes in the environment. The ability to recognize and interpret these scenarios is linked to the visual field, which is made up of both peripheral and foveal vision[1]. While foveal vision allows individuals to focus on specific details, peripheral vision enables to monitor what is happening around [2]. These aspects of vision provide essential information for performing daily tasks, such as navigation, where it's important to be aware of both the body's position and the objects nearby. We used fNIRS to detect differences in neural activity when central and peripheral vision stimuli are presented.

Material, Methods and Results: This study aims to determine whether fNIRS signals can distinguish cerebral responses to visual stimuli presented in central vision versus those in the peripheral. The experiment featured the projection of an optotype based on the Snellen chart that moved across the horizontal plane in two stages: first within the central vision, and then outside that field while the subject maintains focus on the center. Brain hemodynamic responses were recorded using the NIRx NIRScout device, which employed eight detectors and 16 emitters arranged over the somatosensory cortex and occipital lobe. Data processing was carried out using a custom Python algorithm, which performed a comparative analysis of various classification models based on statistical features and determined channels exhibiting the most significant differences. As a result, the algorithm distinguished between events involving foveal and peripheral vision. Additionally, it was possible to identify the region where variability is greater (see Fig. 1) and also determine that the Boosted Trees model achieved the highest classification accuracy (0.833) in these instances.

Conclusion: This study demonstrates the capability of fNIRS to distinguish neural activity between central and peripheral vision, highlighting its potential as a less invasive method for monitoring brain activity. Simultaneously, it provides valuable insights for the development of Brain-Computer Interface (BCI) systems using fNIRS-based neural signals to assist with navigation through vision. These findings serve as a starting point for future research, setting the stage for the creation of more advanced systems aimed at improving navigation and interaction through neural signals.

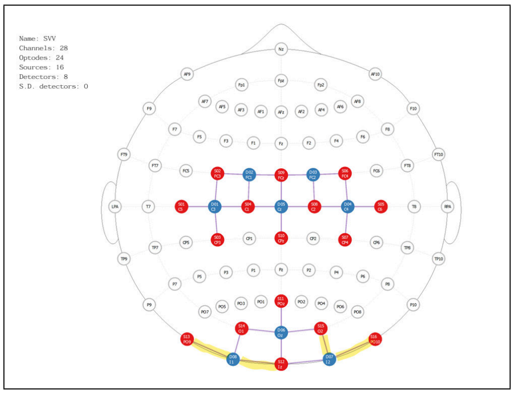

Figure 1: *Region identified with significant difference in central and peripheral vision*

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References:

[1] Stewart EEM, Valsecchi M, Schütz AC. A review of interactions between peripheral and foveal vision. In *Journal of Vision*, 20(12):2–2, 2020. https://doi.org/10.1167/jov.20.12.2

[2] Vater C, Wolfe B, Rosenholtz R. Peripheral vision in real-world tasks: A systematic review. In *Psychonomic Bulletin & Review*, 29(5):1531–1557, 2022. https://doi.org/10.3758/s13423-022-02117-w

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