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► To cite this version:

C. Caredda, L. Mahieu-Williame, R. Sablong, M Sdika, J. Guyotat, et al.. Real time intraoperative functional brain mapping using a RGB camera. Colloque RITS, May 2019, Tours, France. hal-02142491

HAL Id: hal-02142491

<https://hal.science/hal-02142491>

Submitted on 28 May 2019

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Real-time intraoperative functional brain mapping using a RGB camera

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Introduction

Context: Non invasive functional brain mapping is an imaging technique used before brain tumor resection to localize the functional areas of the patient brain. f-MRI and electrical brain stimulation are two complementary clinical tests realized before neurosurgery.

f-MRI tests are realized before the patient craniotomy. Electrical brain stimulation tests are realized once the patient cortex is exposed.

Background: Optical imaging can be used to monitor the brain activity [1] with the measure of hemoglobin concentration changes ($\Delta[\text{HbO}_2]$ and $\Delta[\text{Hb}]$). A device consisting of a continuous wave white light illumination and a RGB camera is a suitable approach [2].

Objectives: We propose to realize a real time intraoperative localization of brain functional areas using a RGB camera with the analysis of $\Delta[\text{HbO}_2]$ and $\Delta[\text{Hb}]$ time courses which is closely linked with the Bold contrast in f-MRI studies.

Material & methods

Experimental paradigm: After the patient craniotomy and before the brain tumor resection surgery, the patient was awakened and functional tests have been realized. The stimulation of the motor cortex was achieved through a repetitive and alternative hand opening and closing at $\approx 1\text{Hz}$. The paradigm consisted of 3 steps : 30s of rest, 30s of stimulation and 30s of rest. The neurosurgeon realized electrical brain stimulations to localize the patient brain motor and sensory areas.

Results

Hb real-time functional quantitative maps

✓ The Hb functional quantitative maps correspond to the motor and sensory areas validated by the neurosurgeon.

✓ Relevance of the functional quantitative maps as soon as the patient activity is established.

Discussion & conclusion

↗ A global mean path length is calculated for all camera pixels. A pixel-wise computation of the mean path length is required.

↗ The correction of the collected intensity slope is not optimal for the first maps (from C₁ to C₆). This problem will be investigated in a future work.

↗ The functional quantitative maps processing time depends on the amount of pixels contained in the region of interest. CPU and GPU optimization code is required.

References

- [1] Chance B. et al. Proceedings of the National Academy of Sciences 90, 3770–3774 (1993).
- [2] Malonek D. et al. Science 272, 551–4 (1996).
- [3] Sdika M. et al. Medical Image Analysis 53, 1–10 (2019).
- [4] Kohl-Bareis M. et al. Apparatus for measuring blood parameters (2012).
- [5] Fang Q. et al. Optics express 17, 20178–20190 (2009).
- [6] Veldsman M. et al. Human Brain Mapping 36, 1620–1636 (2015).