Bimodal EEG-fMRI Neurofeedback for stroke rehabilitation

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BACKGROUND

Neurofeedback (NF) has potential to be applied for stroke rehabilitation [1],[2] however the effectiveness of NF for stroke has not been thoroughly assessed yet.

Bimodal EEG-fMRI NF [3],[4] is a promising technique to achieve a more efficient and specific self-regulation, which may be crucial for clinical application.

AIMS

Within the project **HEMISFER** (Hybrid Eeg-MrI and Simultaneous neuro-FEedback for brain Rehabilitation), the aims of this preliminary study are to:

- **Test the feasibility of applying bimodal EEG-MRI NF for stroke rehabilitation in two chronic patients affected by left hemiplegia (subcortical lesion).**
- **Identify problematics and guidelines in view of a clinical study on stroke patients.**

METHODS

Experimental Platform

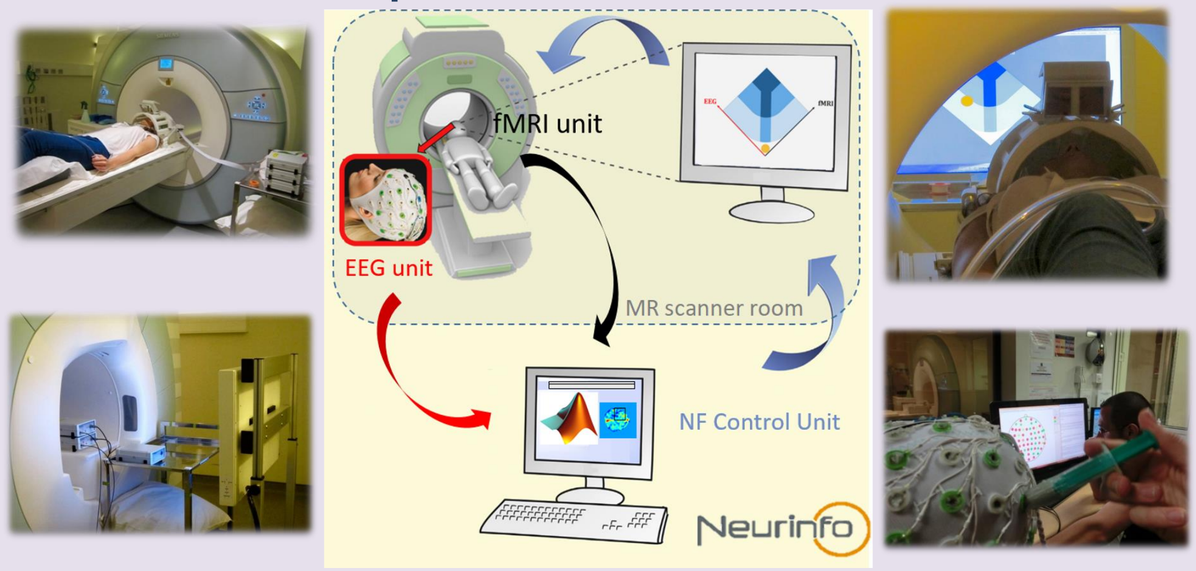

Figure 1. Bimodal EEG-fMRI NF platform [5] (Neurinfo, CHU Pontchaillou, Rennes). *The platform integrates and synchronizes EEG and fMRI subsystems and signal flow for the computation and visualization of the bimodal NF.*

Neurofeedback Protocol

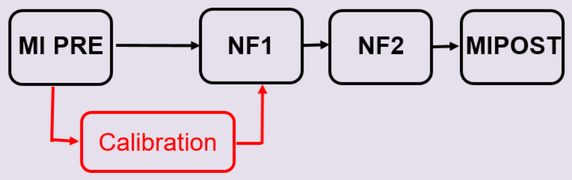

Figure 2. Schematic of the experimental protocol. *Each session consisted of 8 blocks of 40 s (20 s rest, 20s task). MI=Motor Imagery (without NF display). MI_PRE=preliminary session used for calibration (ROI, EEG filter). MI_POST=transfer session.*

PRELIMINARY RESULTS

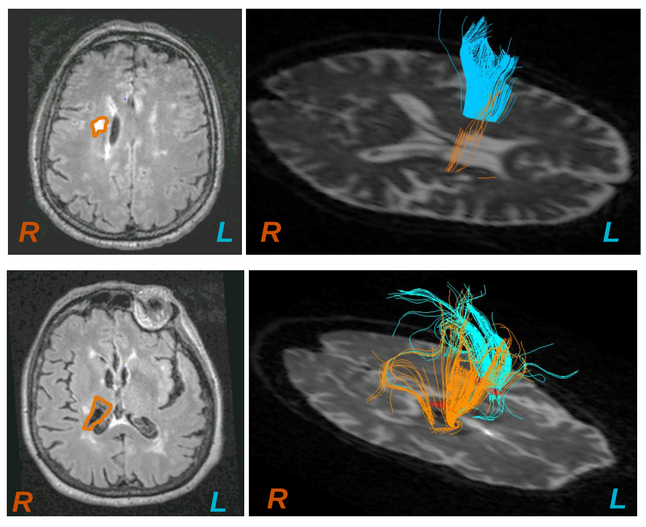

Figure 3a. Lesion and cortico-spinal tract (CST) of patient 1 (Right ischemic stroke). T*he CST was estimated from tractography of diffusion weighted images [6].*

Figure 3b. Lesion and CST of patient 2 (Right hemorrhagic stroke)

Ipsilesional
Contralesional

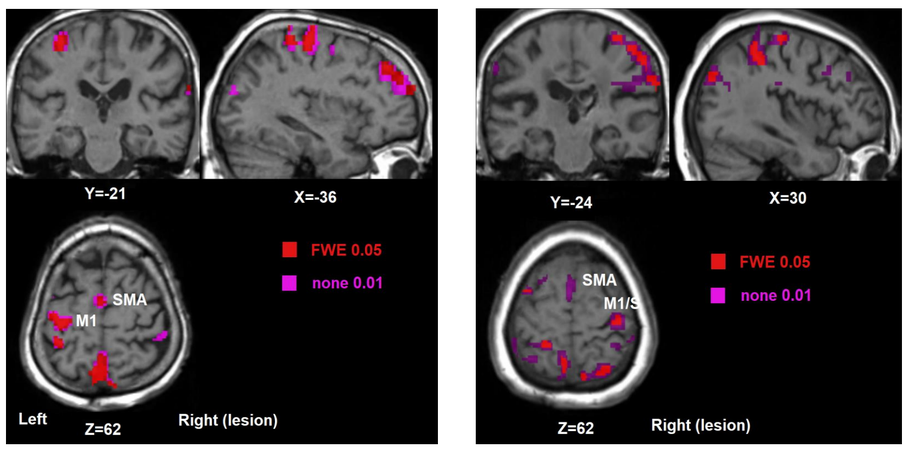

Figure 5. Average BOLD activations maps over the two NF sessions for patient 1 (left) and 2 (right) *(TASK>REST; k > 10 voxels).*

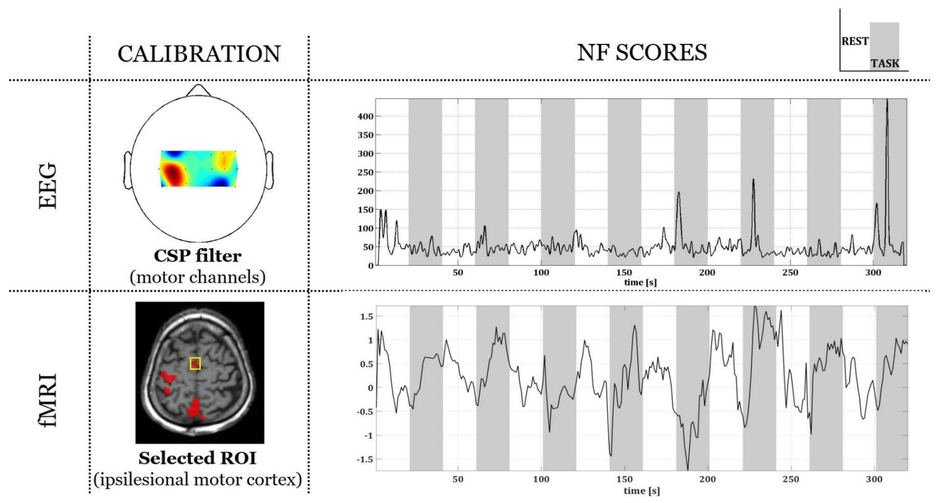

Figure 4. EEG and fMRI NF scores during a NF session. *Example from one patient (1). The left column shows the filter and the ROI selected for NF computation during calibration.*

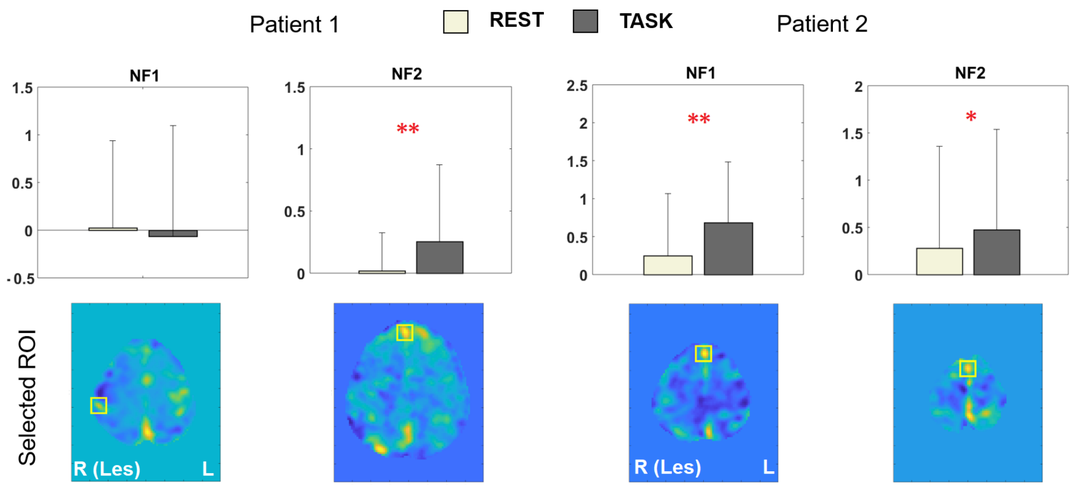

Figure 6. fMRI signal regulation as a function of the selected ROI*. The bar plots represent BOLD activity in the selected ROI with respect to background (mean+std across blocks) during rest and NF. Relative statistics are showed (Wilcoxon tests, * p<0.05, ** p<0.01)*

CURRENT AND FUTURE WORKS

- **Improve performances and simplify the workflow of the bimodal NF platform.**
- **Clinical study on Stroke patients to test the efficacy of multisession bimodal NF for rehabilitation.**

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