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# Brain hemodynamic and electrical activity during functional upper limb movements in chronic stroke



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## INTRODUCTION

Two-thirds of stroke survivors suffer from persistent functional limitations of their paretic upper limbs (UL). To cope with this persistent sequel, a good understanding of UL recovery mechanisms is needed. Portable functional neuro-imagery could be easily used for brainmovement evaluation to highlight neuroplasticity mechanisms during rehabilitation.

Objective: To fuse fNIRS and fEEG methods to evaluate sensorimotor cortical (SMC) activity during UL movements

### METHODS

### **Participants:**

- 3 chronic stroke patients (mean age = 59 years, >6 months post-stroke)
- Upper limb impairment (mean FM-UE = 48/66)

### **Experimental protocol (Fig.1):**

- 3 blocs of 20s of each functional task (Fig. 1) with paretic and non-paretic UL
- Synchronized recording of brain (fNIRS, fEEG, Fig. 2) and movement (Kinect, graphic tablet pad) parameters

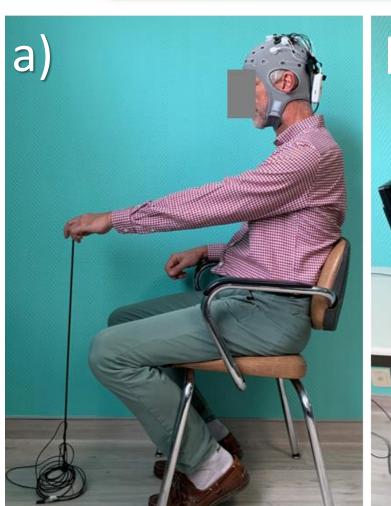


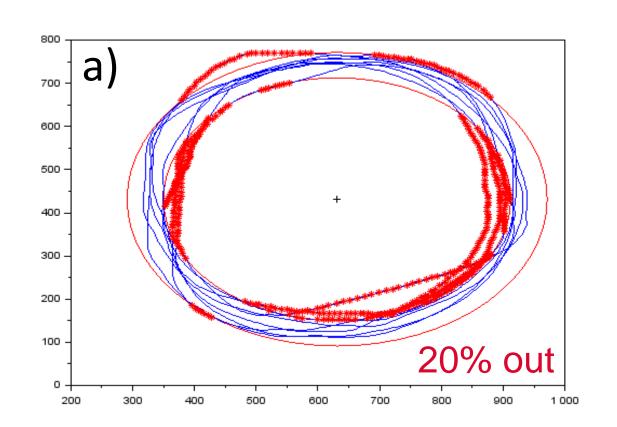








Fig 2. fNIRS and fEEG layout over the SMC region



RESULTS

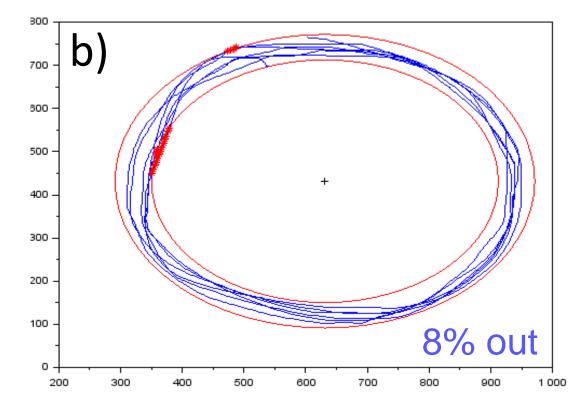


Fig 3. Movements of the paretic arm (a) and non-paretic arm (b) for the circular steering task in one patient

Kinematics (Fig. 3): lower performances with paretic UL

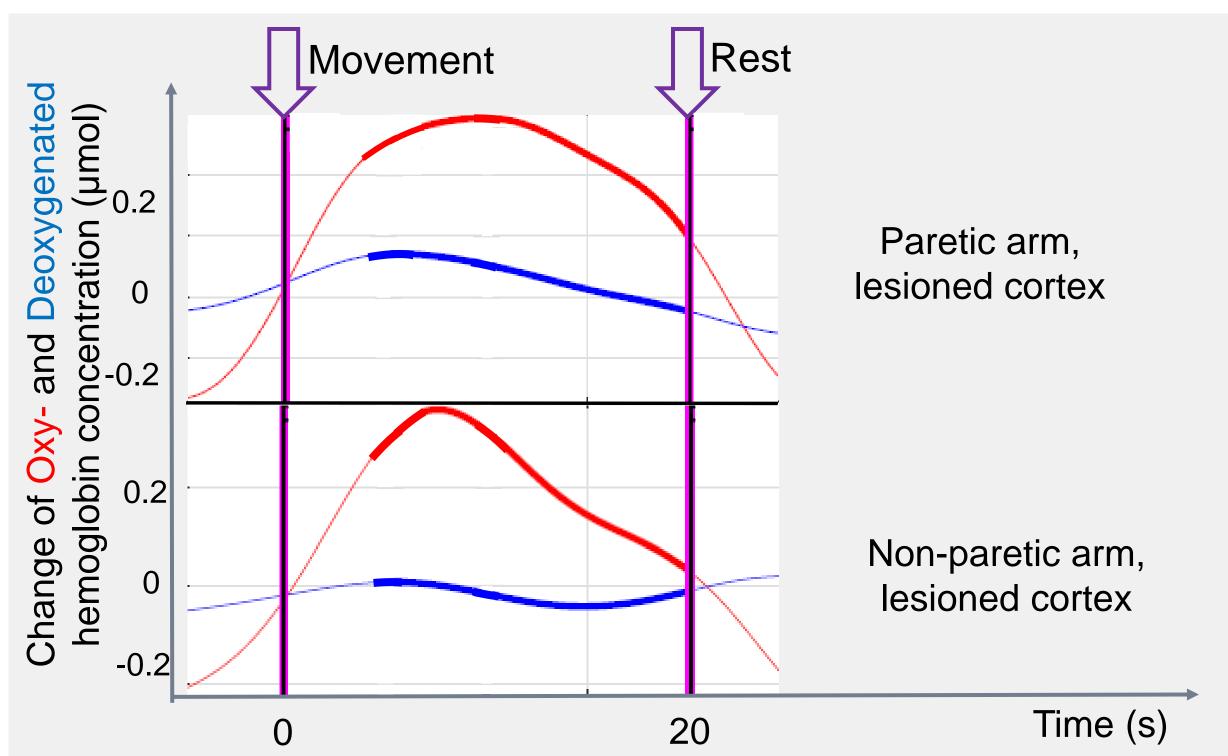


Fig 4. fNIRS hemodynamic response during circular movements

fNIRS provides (Fig. 4) information about:

- Level of SMC activation (†oxygenated blood)
- Ipsilateral and contralateral SMC difference

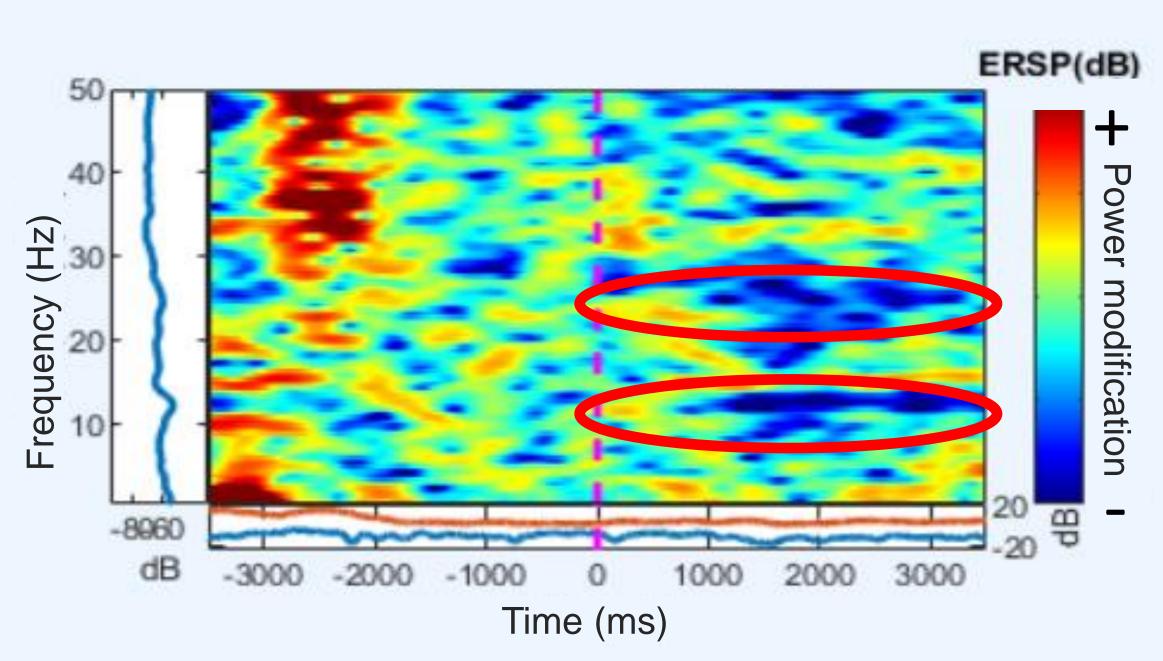


Fig 5. Power modification in Alpha and Beta bands during circular movements

## DISCUSSION

- Neuromonitoring platform to explore movementrelated neurovascular coupling mechanisms
- Relative ease of installation provides a routine way to explore level of neuroplasticity during stroke rehabilitation
- Long term objective: precision medicine

fEEG provides (Fig. 5) information about:

- (14-35Hz) power)
- Ipsilateral and contralateral SMC difference

Reference - Muller, C.O., et al. Recovering arm function in chronic stroke patients using combined anodal HD-tDCS and virtual reality therapy (ReArm): a study protocol for a randomized controlled trial. Trials 22, 747 (2021).

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