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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 **brain-movement 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

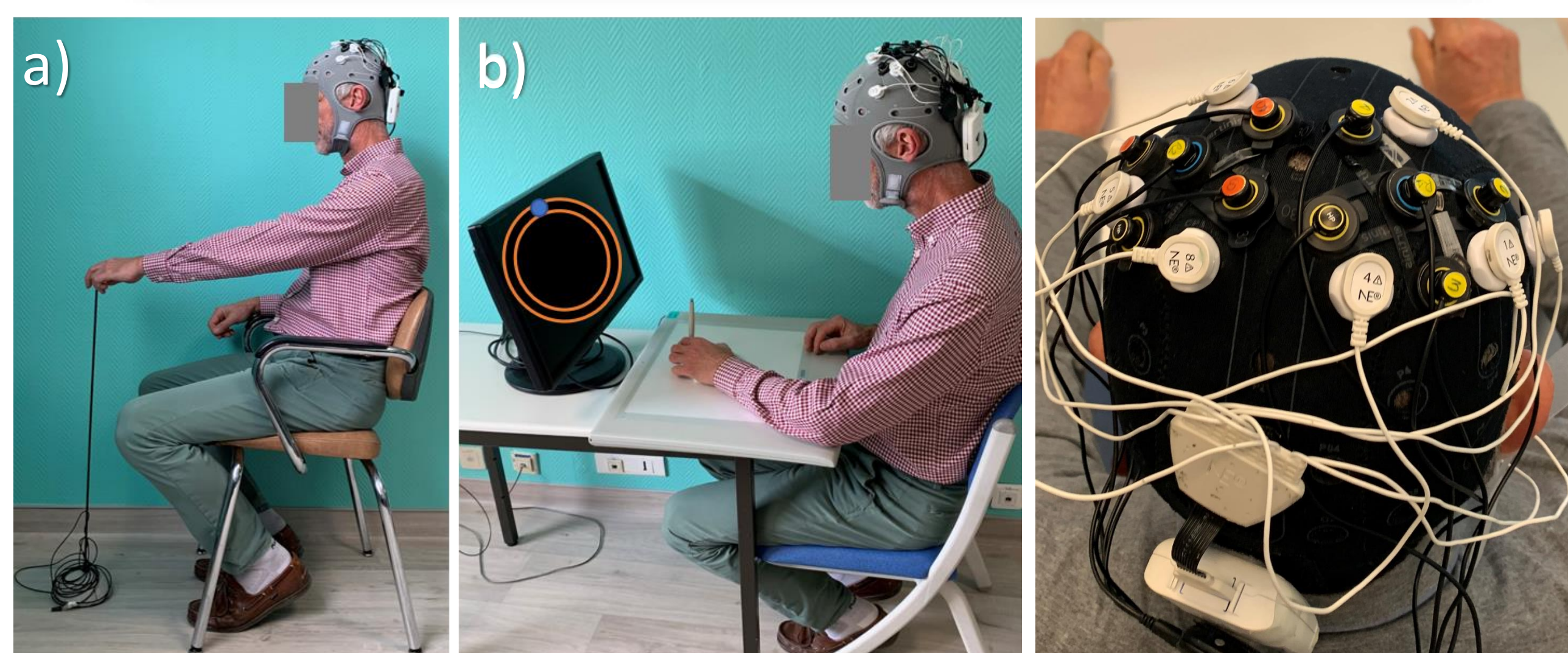


Fig 1. a) Reaching and b) Circular steering tasks

Fig 2. fNIRS and fEEG layout over the SMC region

DISCUSSION

• **Neuromonitoring** platform to explore movement-related neurovascular coupling mechanisms

• **Relative ease of installation** provides a **routine** way to explore level of neuroplasticity during stroke rehabilitation

• Long term objective: **precision medicine**

RESULTS

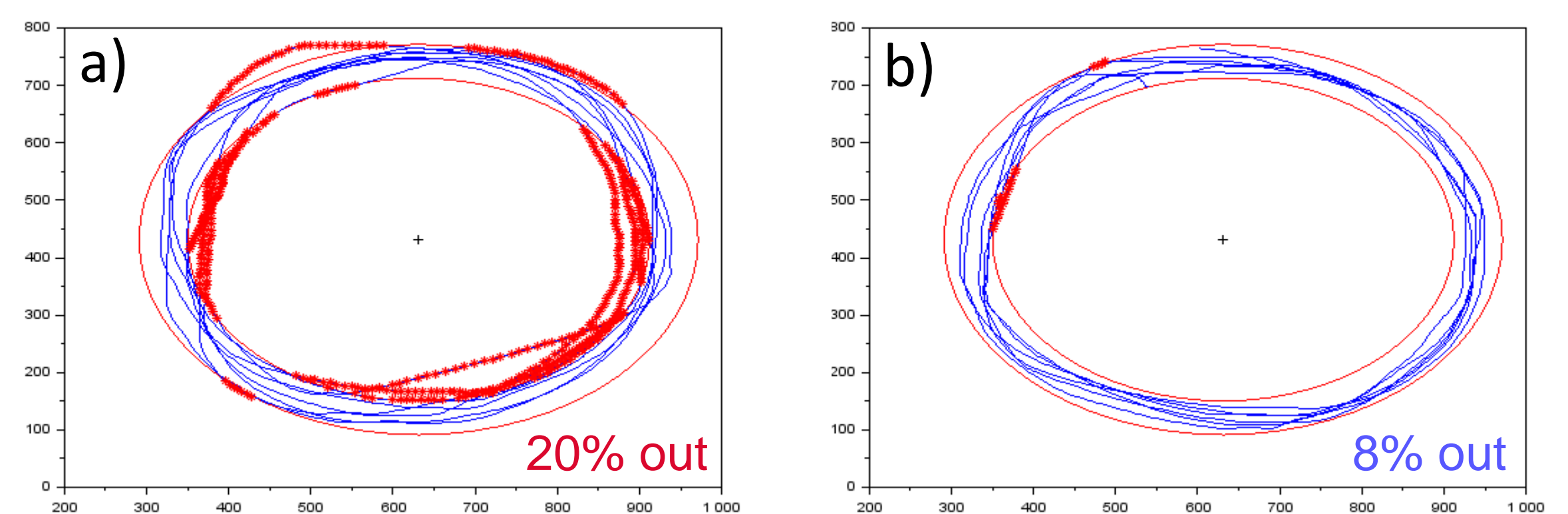


Fig 3. Movements of the paretic arm (a) and non-paretic arm (b) for the circular steering task in one patient

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

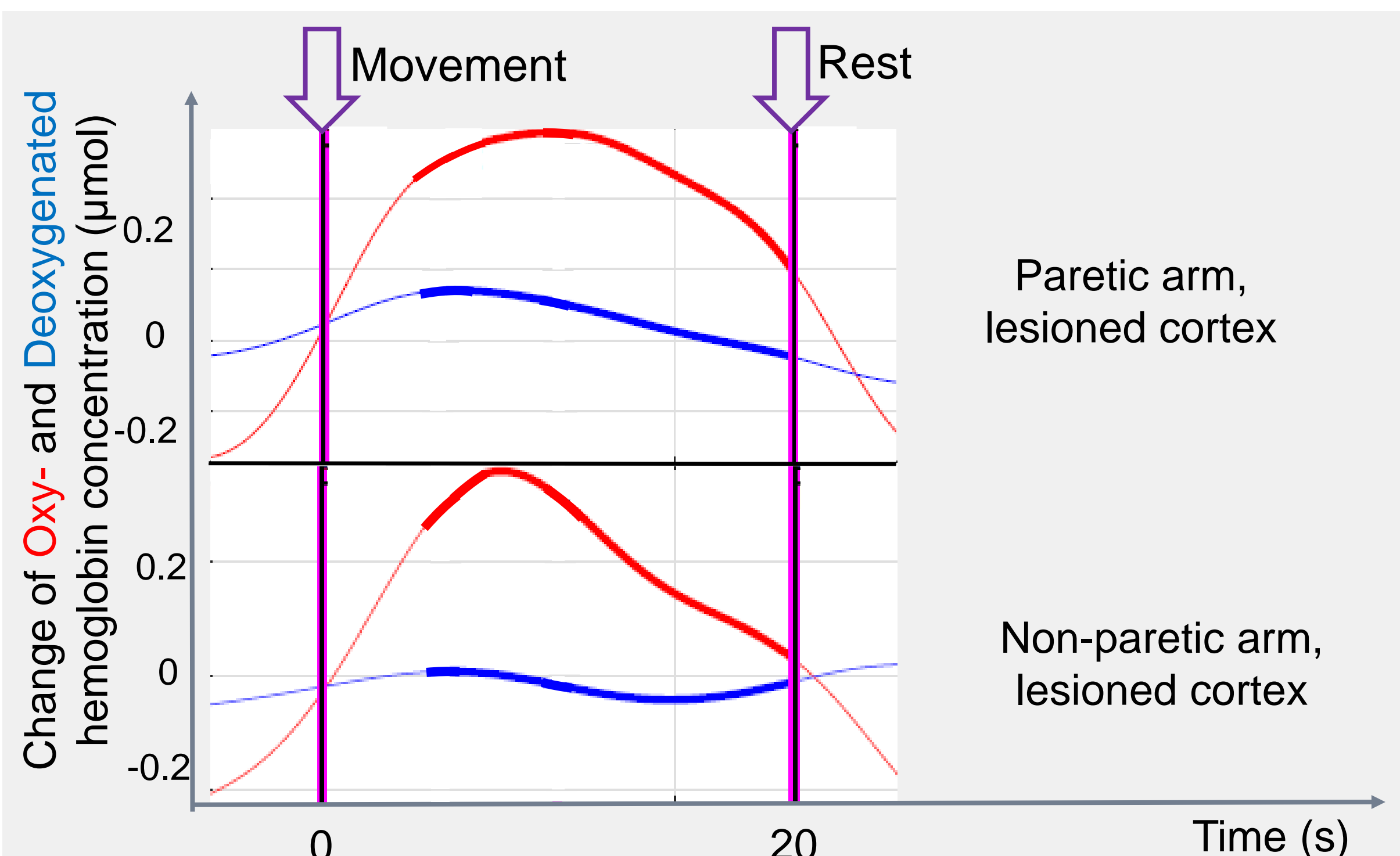


Fig 4. fNIRS hemodynamic response during circular movements

fNIRS provides (Fig. 4) information about:

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

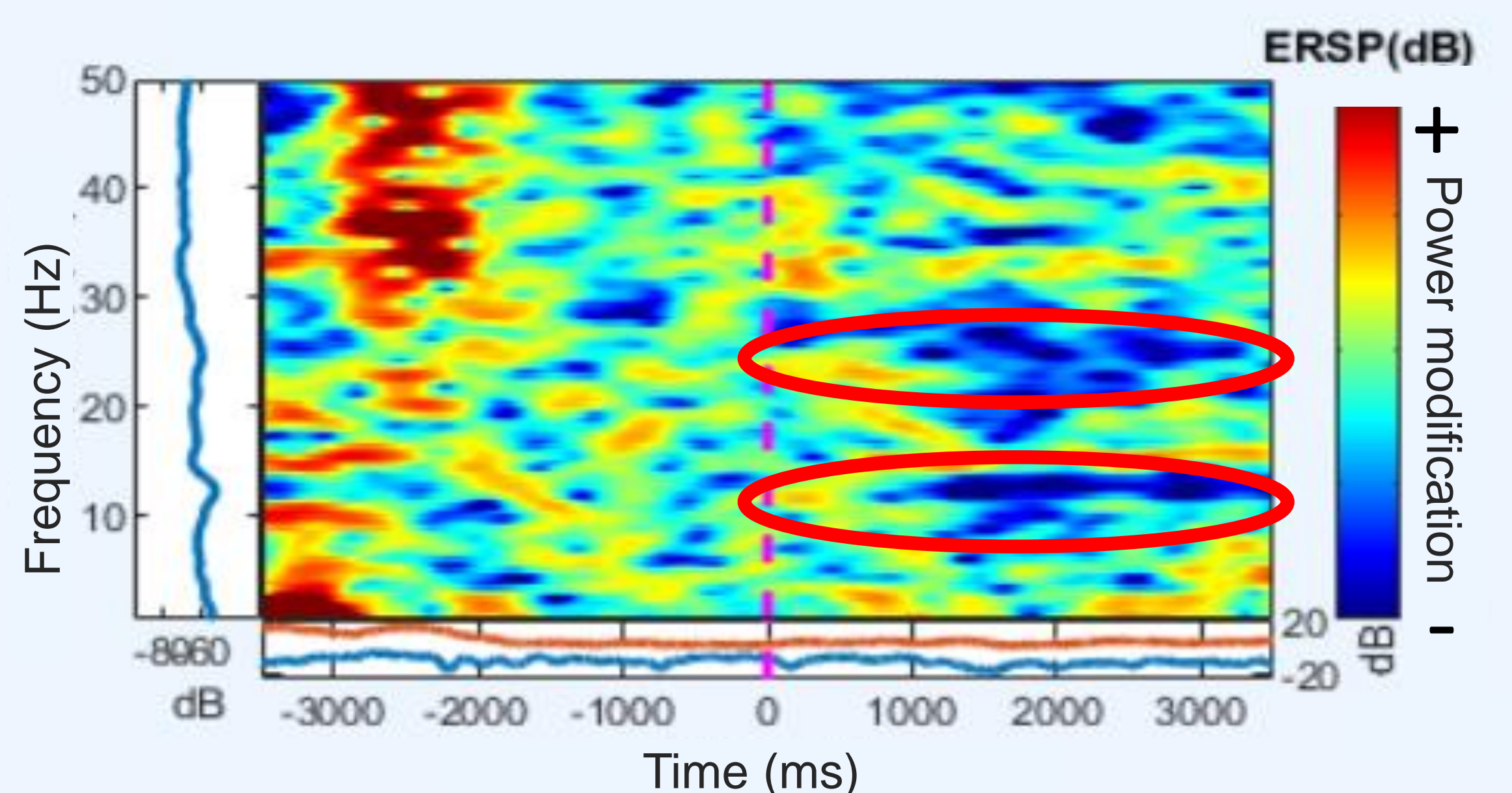


Fig 5. Power modification in Alpha and Beta bands during circular movements

fEEG provides (Fig. 5) information about:

- Level of **SMC excitability** (**↓ Alpha (8-13Hz) and Beta (14-35Hz) power**)
- **Ipsilateral and contralateral SMC** difference