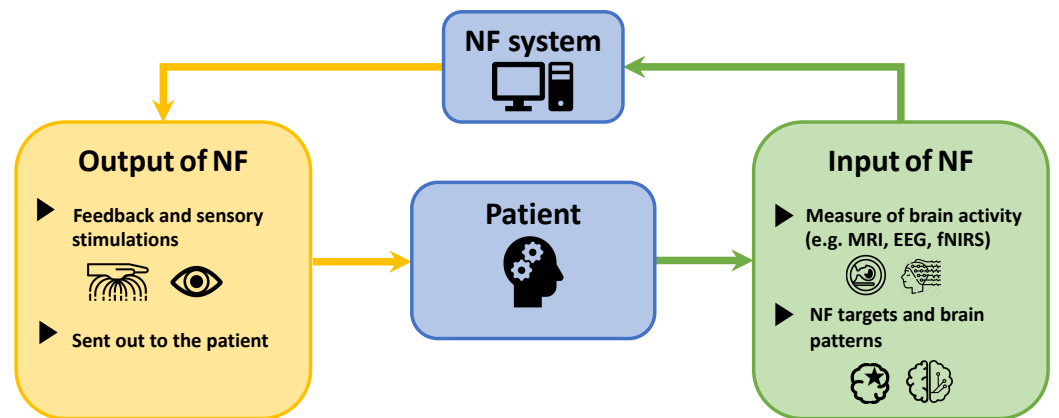


Neurofeedback (NF)

- Consists in presenting a subject with a stimulus directly related to his/her current brain activity
- Can be used to teach subjects to regulate their own brain functions
- Previous studies showed that multimodal (e.g. EEG/fMRI) NF is promising for the treatment of various neuronal pathologies, such as post-stroke rehabilitation

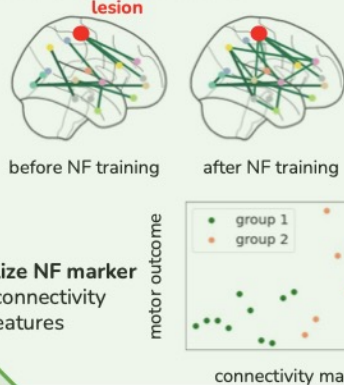


PEPERONI project: 2022-2024

NF for PRECISION MEDICINE

PERSONALIZED: adapted to patient profile

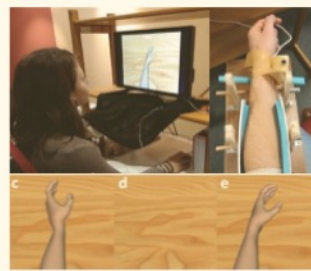
1. CONNECTIVITY NF INPUT



personalize NF marker with connectivity features

2. MULTISENSORY NF OUTPUT

adapt the feedback (visual + haptic) to the patient and the task to facilitate neuromodulation

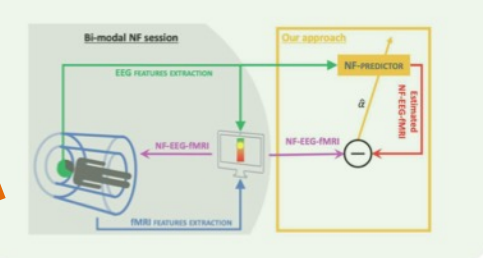


Methodological development
EEG+fMRI datasets (N=60)

New NF Protocols
Proof of concept on stroke patients

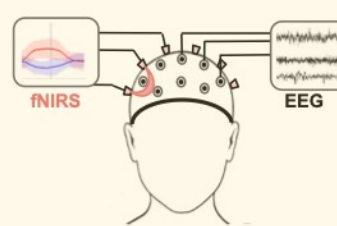
1. EEG-only, fMRI "enriched"

Learn a joint EEG-fMRI model to predict fMRI connectivity in EEG-only setting
**ongoing PhD Thesis*



2. EEG + fNIRS

High spatial (fNIRS) and temporal (EEG) resolution with lighter solutions, more adapted to clinical use



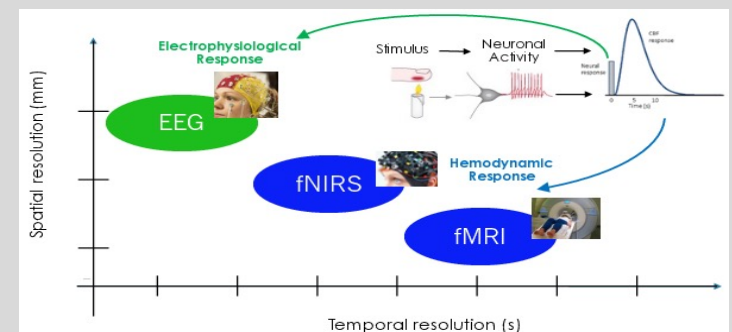
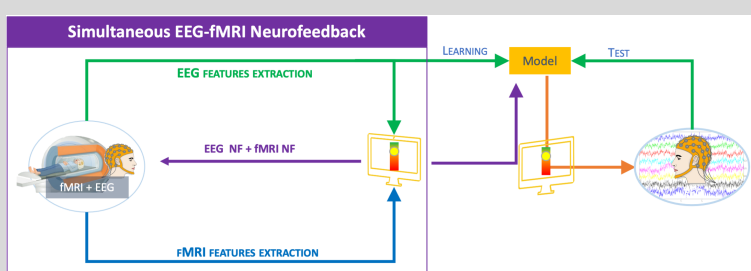
PORTABLE: adapted to clinical practice

- F. Le Jeune, postdoc, from March 2023
- Adapted feedback: reduce the time required to learn to control the system and their brain activity
- Adaptation depending on: personal characteristics of users, evolution of their results
- Start of a new clinical trial: haptic EEG neurofeedback in early stages of stroke (44 patients)
- Study on new thermal feedback

- C. Muller, postdoc, from Oct. 2023
- fNIRS and fMRI measure the hemodynamic response
- Study impact of fNIRS for NF
- Propose a new EEG-fNIRS NF acquisition protocol
- Design a proof-of-concept study on stroke patients

- A. Lamouroux, PhD student, from Oct. 2022, funded at 75% by CominLabs
- How to process fMRI data from stroke patients?
- fMRIStroke: new preprocessing pipeline + evaluation
- On existing data: assessing changes induced by NF training on brain networks organization
- Identify new connectivity-based biomarkers)

- C. Pinte, PhD student, from Oct. 2021, not funded by CominLabs
- Preliminary work during former CominLabs project Hemisfer
- Investigating long short-term memory (LSTM) and temporal convolutional neural networks (TCN)



Consortium

- Empenn U1228 (Inria/Inserm/CNRS/UR1)
 - Julie Coloigner, CR CNRS
 - Claire Cury, CR Inria
 - Pierre Maurel, PR UR1
- HYBRID Team (Inria/IRISA)
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 - Giulia Lioi, MCF IMT
- Rehabilitation Dept. CHU Rennes
 - Isabelle Bonan, PU-PH