Synchronized EEG-fNIRS for Enhanced Brain Source Validation in real settings

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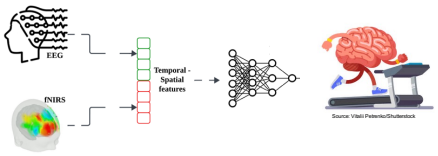
1 INTRODUCTION – RESEARCH QUESTION

Together, electroencephalography (EEG) and functional near-infrared spectroscopy (fNIRS) offer a **multimodal approach** that addresses the weaknesses of each method, enabling more accurate and robust brain mapping in **naturalistic settings** (rehabilitation, sport, movement).

How can the integration of mobile EEG and fNIRS, enhanced **by machine learning**, improve the accuracy and ecological validity of brain source localization and brain measures/biomarker classification during real-world environments?



2 AIMS OF THE INTERNSHIP

1 **Establish the feasibility and validity of synchronized mobile EEG-fNIRS in real-world settings.**

Objective: Deploy and evaluate the technical stability, signal quality, and usability of a mobile EEG-fNIRS system during dynamic physical activity.

Outcome: Demonstrate reliable multimodal data collection under real-world movement conditions.

2 **Enhance cortical source localization through multimodal data fusion.**

Objective: Develop and validate algorithms that combine EEG's temporal precision with fNIRS's spatial accuracy to improve cortical source mapping.

Outcome: Achieve significantly improved spatial resolution and specificity in identifying brain activation patterns compared to EEG alone.

3 **Apply machine learning to classify cognitive states from fused EEG-fNIRS data.**

Objective: Train and evaluate machine learning models to detect brain measures/biomarkers during sports performance using integrated multimodal features.

Outcome: Create predictive models capable of real-time classification with high accuracy, enabling adaptive feedback systems.

3 INTERNSHIP KEY POINTS

By combining EEG and fNIRS ML techniques can improve source localization and pattern recognition, enabling deeper insights into cognitive states → enables advanced predictive modeling of brain activity, in complex and dynamic environments.

- **Exercise Neuroscience**
- **Brain monitoring assessment**
- **Machine learning & time series**
- **Applied interdisciplinary work**

4 ABOUT SUPERVISION

The internship will be supervised by **a mixed team** from the *EuroMov Digital Heah in Motion* and *Exercise science & Neuroscience* Research Units **specialists in human movement, neuroscience and machine learning** applied to brain signals

References

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