Riemannian Geometry for fNIRS-BCIs and other clinical applications

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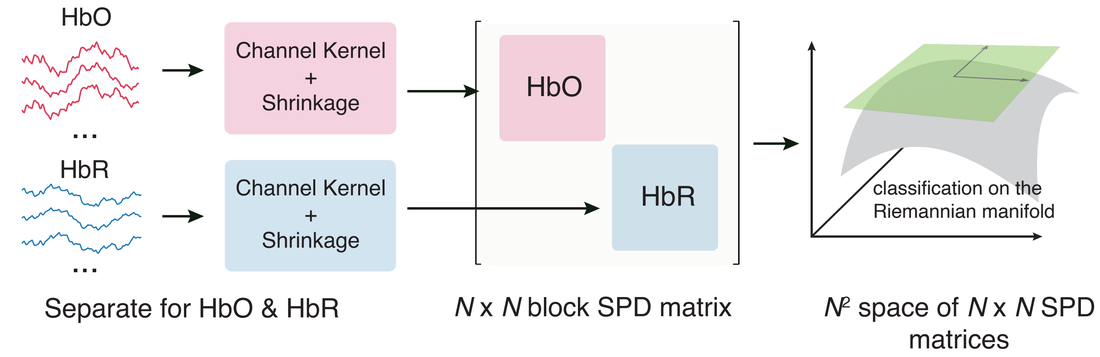
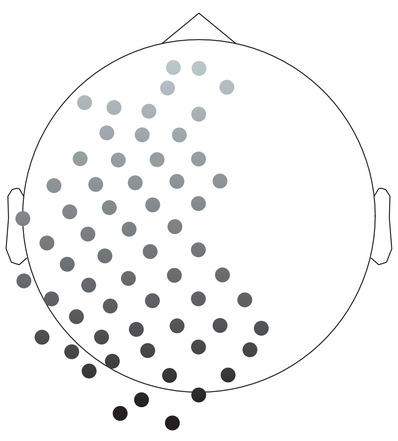
INTRODUCTION

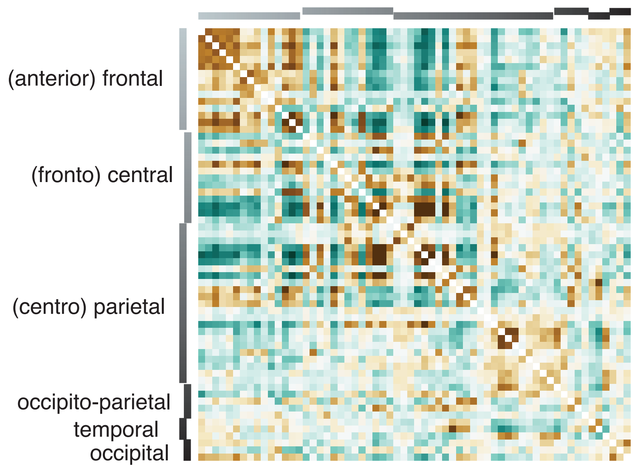
Functional near-infrared spectroscopy (fNIRS) has become a popular tool for brain-state assessment due to its portability, non-invasive nature, and resilience to movement[1,2,3]. However, compared to fMRI, fNIRS has limitations in terms of brain coverage and sensitivity to deeper brain activity. Additionally, advancements in fNIRS-based classification methods have not received as much attention as in fMRI, resulting in lower performances. In this study, we present a classification approach leveraging Riemannian geometry to enhance the accuracy of brain-state classification using fNIRS data. We also successfully applied this framework to a clinical proof-of-concept paradigm aimed at diagnosing remaining consciousness in patients with disorders of consciousness (DoC).

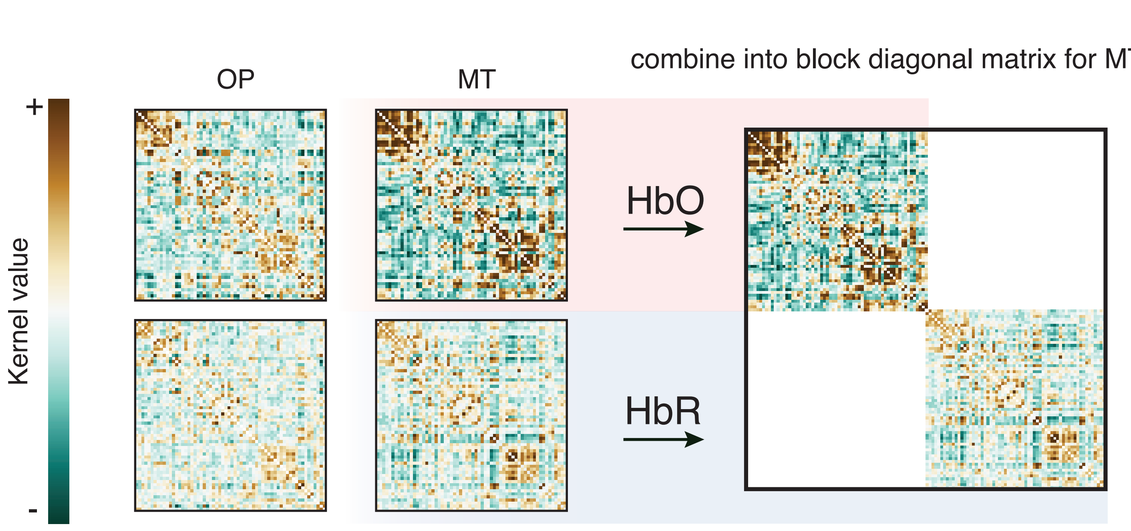
MODEL & KERNEL MATRICES

Preprocessing → Hyperparamter tuning → Feature construction → Riemann-based Classification

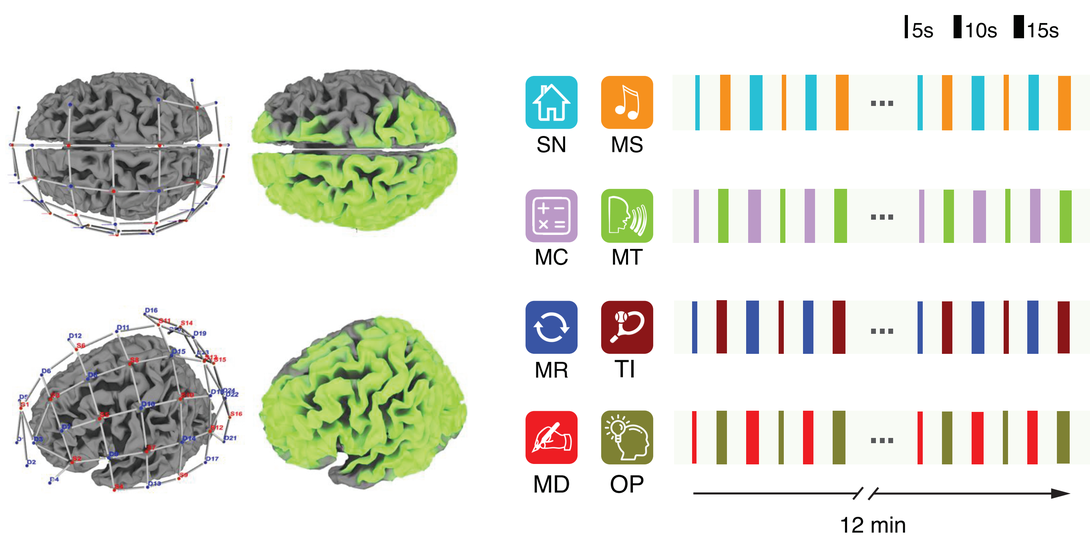




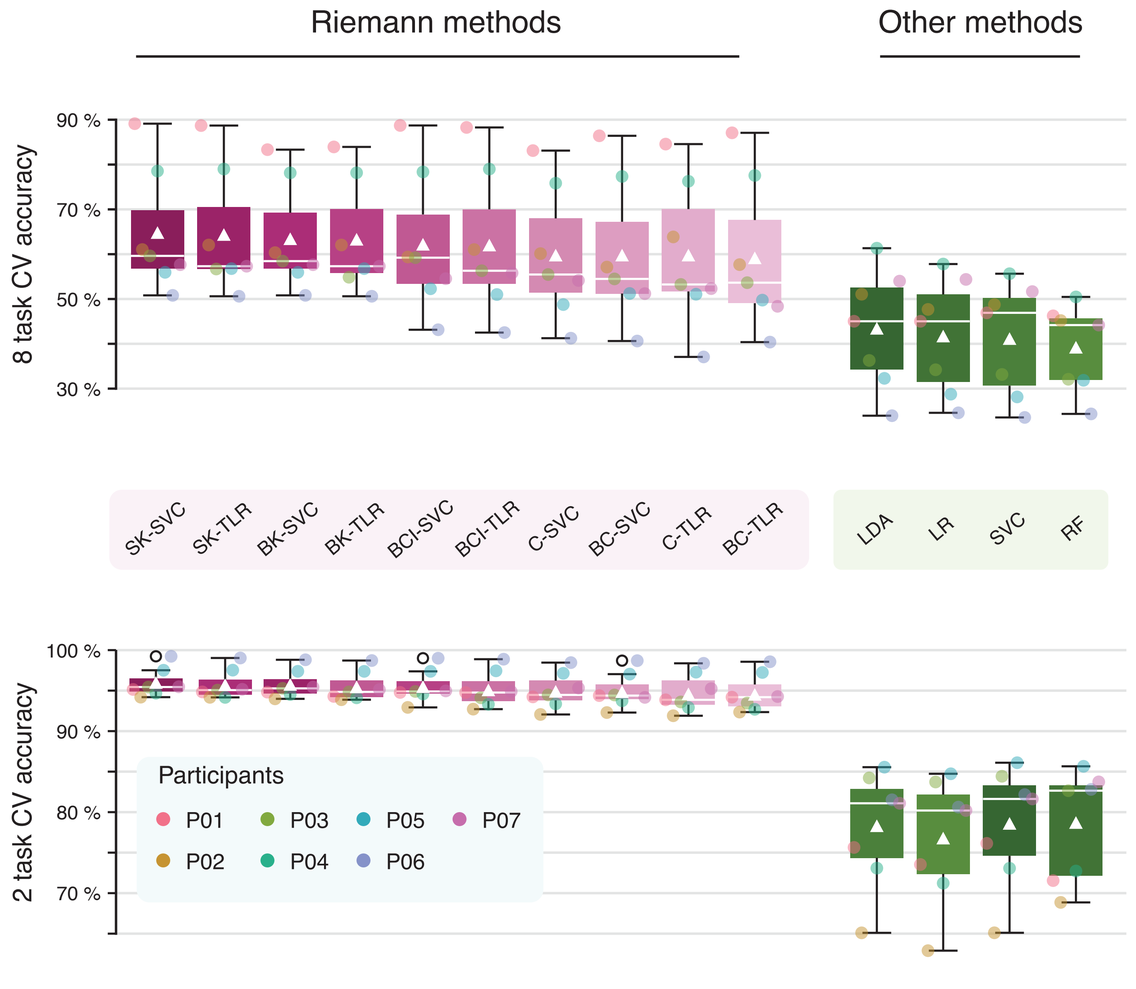




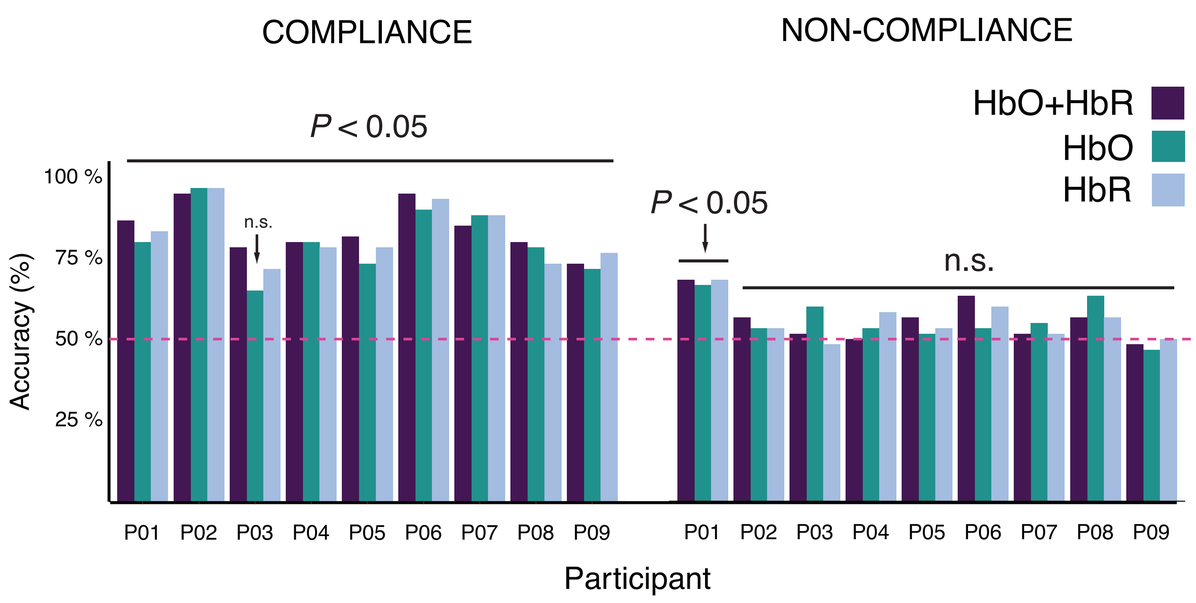
EXPERIMENTAL PARADIGM



CLASSIFICATION RESULTS



CLINICAL APPLICATION



References

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3 S. R. Soekadar, S. H. Kohl, M. Mihara, et al., "Optical brain imaging and its application to neurofeedback," NeuroImage: Clinical 30, 102577 (2021).

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