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Classification of upper extremity function in stroke using magnetic resonance imaging acquired during Brain-computer interface protocols for neurorehabilitation

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Introduction: Upper extremity (UE) motor function is highly relevant for assessing the clinical and neuroplastic effects of brain-computer interfaces (BCI) aimed at stroke neurorehabilitation. However, trained personnel and specialized material are needed for performing clinical assessments of the UE. Magnetic resonance imaging (MRI) is already employed for stroke diagnosis and could also be used for UE motor function assessment within BCI protocols.

Material, Methods and Results: In this study, a dataset acquired during two BCI studies aimed at stroke neurorehabilitation with the ReHand-BCI system was used [1]. The dataset was comprised by 85 measurements of UE sensorimotor function measured with the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) [2], functional performance measured with the Action Research Arm Test (ARAT) [2], as well as diffusion tensor imaging (DTI) obtained from MRI. The ratio of fractional anisotropy, a measure of interhemispheric white matter integrity was computed from the DTI sequences across 21 regions of interest. These features were used to classify if patients had UE motor function in their paralyzed hand using a hyperparameter-free machine learning algorithm [3]. For FMA-UE the model had a classification accuracy of 88% while for ARAT it was 81%. For assessing FMA-UE, the white matter interhemispheric integrity of the superior coronata radiata was the most important feature, while for ARAT, it was the posterior limb of internal capsule, as shown in Fig.1.

Conclusion: Interhemispheric white matter integrity can be used to detect if stroke patients present UE motor function in their paralyzed hand during BCI neurorehabilitation interventions.

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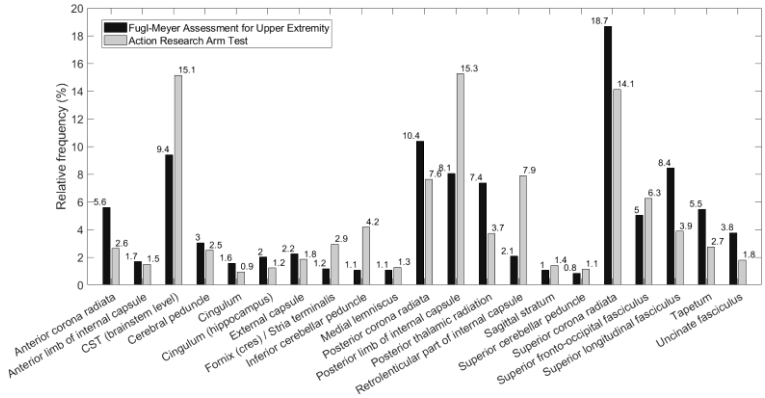

Figure 1: *Importance of regions of interest within the corticospinal tract (CST) for the classification of upper extremity motor function.*

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