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MENTAL MOTOR IMAGERY CLASSIFICATION FOR DEVELOPMENT OF NEUROFEEDBACK PROCEDURES FOR NEUROREHABILITATION

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Background

Mental-Motor Imagery (MI) is *an ability to generate the mental correlate of motor and perceptive events (also visible in EEG signal) in the absence of external output (motor action)[1]. Sensorimotor Rhythm (SMR) is a brain wave and an oscillatory idle rhythm of synchronized electric brain activity over the* ***sensorimotor cortex****, which changes are visible during motor preparation and execution, as well as, during motor imagery.* **Neurofeedback** (NF) *is a type of a biofeedback technique used for symptom alleviation of various neurological and psychiatric disorders[2]. It* ***requires*** *a series of analysis procedures for real-time* ***identifying*** *and* ***classifying*** *the particular cerebral EEG signals and features related to the MI.*

It is known that MI has been used in various **neurorehabilitation** *protocols, however, the effectiveness of the therapy is unpredictable because of the uncontrollable conditions (it is unknown if subject performs the task of Motor Imagery or not). Therefore, NF is required, and thus, the underlying mechanisms of 1)* ***acquisition****, 2)* ***preprocessing****, 3)* ***detection****, 4)* ***classification*** *are essential. Additionally, recent studies show the importance of the type of stimuli presentation during NF session that facilitates* ***first-person perspective*** *(implicit) MI, with the hypothesis that this perspective is more effective for rehabilitation.*

1) Acquisition

Objectives

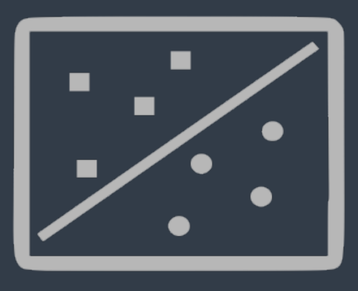
- *Development of NF underlying mechanisms of* ***acquisition****,* ***pre-processing*** *(e.g. artifact removal, frequency filtering, EEG channel selection for the online session),* ***detection*** *and* ***classification*** *(e.g. feature selection, classifier selection, etc.)*
- *Development of a novel stimuli presentation that* ***facilitates human-computer interaction*** *(i.e. immersion) and helps patients* ***adopt the proper strategy*** *for MI*

2) Pre-processing and feature selection

Methods

- *Preliminary study on* ***healthy subjects*** *(planned, university students to examine the system functionality and to conduct preliminary data acquisition)*
- *Clinical study (repeated study* ***clinical population*** *– patients with gait disorders, such as, PD's subjects)*

4) Online NF session



3) Classifier training

Data

- ***EEG*** *(classification accuracy, event-relate (de)synchronisations, entropy)*
- ***Behavioral data*** *(questionnaires)*

Expected Results

Improved NF underlying mechanisms, with the emphasis on the linear and non-linear EEG feature selection, will ***improve reliability*** *of NF protocols used for neurorehabilitation.*

New stimuli presentation can improve human-computer interaction and help subject to ***better understand and adapt the MI during rehabilitation sessions****. It is expected that new stimuli will have a better effect on reinforcement of executive functions (e.g. movement planning), increased activity of the prefrontal areas (i.e. motor planning area), inducing both an increase in the production of SMR and a general relax, and thus, improving patients' quality of life.*

References

1. J. Decety, "The neurophysiological basis of motor imagery," Behavioural Brain Research, vol. 77, no. 1–2. pp. 45–52, 1996.

2. M. Thompson and L. Thompson, "Biofeedback for Movement Disorders: Theory and Preliminary Results," J. Neurother., vol. 6,. 2002.

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