EEG Datasets for Sensorimotor rhythms based Brain Computer Interfaces

Yves Matanga, Karim Djouni, Anish Kurien

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Abstract

Brain Computer Interfaces are alternative communication pathways that allows direct actuator between the brain and an artificial agent. Several endogenous brain computer interfaces use sensorimotor rhythms modulation generated by motor imagery as a control signal for a brain computer interface. The following document provides datasets of a series of bci experiments to drive a computer cursor in one dimension using sensorimotor rhythms modulation. These datasets will be essential in helping researchers investigate on the paradigm considering the scarcity of these datasets during the time of the study (Matanga et al., 2017).

1 Introduction

Brain Computer Interfaces are alternative communication pathways by direct measurement of brain signals, signal processing and actuation of a given artificial agent, thus bypassing the spinal chord. These devices plays a primary role in helping patients with severe neuromuscular disabilities to control artificial agents for locomotion, environmental control and any other activity in order to improve quality of life (Mak & Wolpaw, 2009). Sensorimotor rythms are neuronal signals generally used to drive endogenous brain computer interfaces. BCIs that uses these rythms have attainment the highest degree of freedom control so far (McFarland et al., 2010; Yuan & He, 2014) in endogenous brain computer interfaces. Also called "motor imagery based brain computer interfaces", they have been used mostly for the continuous control of artificial agents (McFarland et al., 2010; Wolpaw & McFarland, 2004; Lafleur et al., 2013; Wolpaw et al., 1991; McFarland et al., 1994) and could reach performances of intracortical BCI systems (). Considering the scarcity of these datasets online, the following document provides datsets for a single dimensional BCI control experiment that used sensorimotor rythms modulation which could researchers further studies in this domain.

2 Experiment Methodology

Five able-bodied patients participated in this experiment (26 ± 2.26 yrs old). They were supposed to control a computer cursor to hit a brick on the left or right of the screen by motor imagery. The BCI design consisted of two stage : An offline phase whereby patients were supposed to a series of limb motor imagination in order to select prominent frequency bands during these activities. Prominent frequency bands were selected and their amplitudes were used as initial features that served as input to the translation algorithm ($y = h(f)$).

During the online phase, selected features were reassed by stepwise regression. And only feature that were relevant in constructing the translation model were kept.

The translation model was a multiple linear regression model :

$$\Delta x = b(S_x(f) - \mu) \tag{1}$$

$$b = \frac{g}{\sigma} \tag{2}$$

$$S_x(f) = \sum_{i=1}^{m} a_i f_i \tag{3}$$

3 Datasets Configuration

The dataset is provided in the matlab "mat" format.

4 Citation Information

The current datasets were used in the following publication : "Analysis of user control attainment in endogenous brain computer interfaces". Yves Matanga, Karim Djouani and Anish Kurien. IEEE Transactions of Neural Engineering and Rehabilitation (under review), May 2017.

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