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Theme F.05 Brain-Machine Interface

F.05.b. BMI neurophysiology – Decoding, neurophysiology and processing

Abstract Title: A Signal Processing method based on Striatal Beat Frequency banking as an aid to improve classification methods for Brain-Computer Interfaces in the context of BCI Competition EEG datasets specific to responses to intensifications of alpha-numeric characters in a matrix.

Review:

A Signal Processing method is presented as an aid to classification methods for Brain-Computer Interfaces (BCIs). The approach is based on the Striatal Beat Frequency (SBF) model and uses a patented method involving single periods of single frequencies (SPSFs). The method is demonstrated using BCI Competition datasets focused on recorded electro-encephalogram (EEG) responses to intensifications of 36 alpha-numeric characters arranged in a 6x6 matrix.

ABSTRACT

This paper demonstrates a method for time-domain analysis of an electroencephalogram (EEG) using the theory of interval timing and Striatal Beat Frequency (SBF). We form a bank of single-period single-frequency (SPSF) sinusoids where the number of points making up each SPSF sinusoid is commensurate with the EEG device sampling rate. We previously demonstrated our method at SfN 2023 in the context of detecting epileptic seizures, and possibly more importantly, the precise detection of the aura via a moving 2 Hz SPSF that preceded the actual seizure. In this paper we apply the same SPSF approach in the context of Brain-Machine Interfacing by utilizing BCI Competition datasets focused on recorded electro-encephalogram (EEG) responses to intensifications of 36 alpha-numeric characters arranged in a 6x6 matrix. While the SfN 2023 paper contrasted SPSF to two other popular methods, specifically Morley Wavelets and Sliding-window FFTs, we will instead focus on our patented SPSF method and discuss how we first imposed strict segmentation rules involving the EEG nodes, the determination of reliable start-stop time intervals of character row/column intensifications, and limitations imposed on the SPSF algorithm due to sampling rate and band-pass filtering.

With the immense increase of computer power in our present day, perhaps the Cooley-Tukey circa 1965 “Fast-Fourier Transform” mind-set, can make room for our “slower”, but more precise, SPSF approach.