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Identification of EEG Attention Level Using Empirical Mode Decompositions for BCI Applications

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Abstract : This paper proposes a method to discriminate electroencephalogram (EEG) signals between different concentration states using empirical mode decomposition (EMD). Brain-computer interface (BCI), also called brain-machine interface, is a direct communication pathway between the brain and an external device without the inherent pathway such as the peripheral nervous system or skeletal muscles. Attention level is a common index as a control signal of BCI systems. The EEG signals acquired from people paying attention or in relaxation, respectively, are decomposed into a set of intrinsic mode functions (IMF) by EMD. Fast Fourier transform (FFT) analysis is then applied to each IMF to obtain the frequency spectrums. By observing power spectrums of IMFs, the proposed method has the better identification of EEG attention level than the original EEG signals between different concentration states. The band power of IMF3 is the most obvious especially in β wave, which corresponds to fully awake and generally alert. The signal processing method and results of this experiment paves a new way for BCI robotic system using the attention-level control strategy. The integrated signal processing method reveals appropriate information for discrimination of the attention and relaxation, contributing to a more enhanced BCI performance.

Keywords : biomedical engineering, brain computer interface, electroencephalography, rehabilitation
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