Preprocessing scalp-recorded EEG

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ABSTRACT

EEG artifact removal and Artifact Subspace Reconstruction (ASR) is discussed in depth. In the conventional manual artifact rejection, we typically scroll multi-channel time-series data page by page to select a time window for rejection. Many researchers have considered this process as most basic and natural approach as long as human resource and their level of experience allow. However, this method fails to live up to expectations in the face of modern research requirements and standards, such as processing a large number (> 102-104) of datasets with complete reproducibility. Besides, I argue that this time-window rejection is actually unnatural because of the discontinuities introduced as a result of arbitrary splicing, which I visually confirm in the time-frequency domain plot. To address these issues, I introduce ASR. ASR is an automated sliding-window linear spatial filter method that targets high-frequency bursts, short or long, suitable for cleaning continuous data. ASR learns a clean part of the data as a reference and applies it after sliding-window component rejection, which distinguishes ASR from an adaptive sliding-window PCA methods. I demonstrate an extreme example using simulation in which 100% of data are rejected according to the conventional time-window rejection with amplitude threshold, while they are 100% salvaged with minimal change confirmed by pre-post ERP waveform comparison. It is concluded that ASR is one of the promising candidates for the dream solution for all EEG researchers about EEG signal preprocessing for artifact rejection.