INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In recent years, the use of portable/wearable EEG systems in health care applications has been increased due its low-power consumption, easy to operate and minimum instrumentation complexity, and reduces the cumbersome to the subject under test. In general, the EEG signals often measured in ambulatory situations, hence, they were contaminated by several artifacts. The presence of these artifacts will degrade the performance of EEG based detection systems. Since the portable EEG devices comprise single or few (at most four) EEG channels, traditional artifact removal techniques, such as blind source separation (BSS), cannot be applied to remove these artifacts. Hence, in this thesis, various subspace based artifact removal techniques for single channel EEG signals were proposed.

Singular spectrum analysis (SSA) is a subspace based technique used in this thesis to remove artifacts from single channel EEG signals. Using the frame work of SSA, first, we proposed new grouping criteria to identify the desired signal (EEG signal) subspace. In this criterion, the local mobility of the eigenvectors is considered and employed for removing the motion artifacts from single channel EEG signals. In addition, SSA is combined with ANC to remove the eye blink artifact in EEG epochs recorded for BCI application.

In general, the measured EEG signal is a mixer of statistically independent source signals. As SSA uses second order statistics (SOS) of the data, the extracted sources are not statistically uncorrelated. Independent component analysis (ICA) is widely used as BSS technique to extract the statistically independent source signals from the mixed EEG data. In order to use ICA in the source separation problem, the number of measured signals should more than or equal to the number of sources to be extracted. Due to this limitation, direct adaptation of ICA on single channel EEG signals is not possible. We investigated this problem and proposed a new scheme such that ICA can be used to process single channel EEG signals. Further, we have also further investigated the performance of the seizure detection algorithm by employing SSA based muscle artifact removal technique as preprocessing step. From the results it is noticed that the adaptation of SSA based muscle artifact removal technique reduces the false positive rate of the seizure detection algorithm.