# Fused multivariate empirical mode decomposition (MEMD) and inverse solution method for EEG source localization


## ABSTRACT

EEG source localization is determining possible cortical sources of brain activities with scalp EEG. Generally, every step of the data processing sequence affects the accuracy of EEG source localization. In this paper, we introduce a fused multivariate empirical mode decomposing (MEMD) and inverse solution algorithm with an embedded unsupervised eye blink remover in order to localize the epileptogenic zone accurately. For this purpose, we constructed realistic forward models using MRI and boundary element method (BEM) for each patient to obtain results that are more realistic. We also developed an unsupervised algorithm utilizing a wavelet method to remove eye blink artifacts. Additionally, we applied MEMD, which is one of the recent and suitable feature extraction methods for non-linear, non-stationary, and multivariate signals such as EEG, to extract the signal of interest. We examined the localization results using the two most reliable linear distributed inverse methods in the literature: weighted minimum norm estimation (wMN) and standardized low resolution tomography (sLORETA). Results affirm the success of the proposed algorithm with the highest agreement compared to MRI reference by a specialist. Fusion of MEMD and sLORETA results in approximately zero localization error in terms of spatial difference with the validated MRI reference. High accuracy results of proposed algorithm using non-invasive and low-resolution EEG provide the potential of using this work for pre-surgical evaluation towards epileptogenic zone localization in clinics.



**Keyword:** BEM; EEG; MEMD; Epilepsy source localization; Inverse solution; Realistic head model