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Minimum Variance Brain Source Localization for Short Data Sequences

***Abstract*—In the electroencephalogram (EEG) or magneto-encephalogram (MEG) context, brain source localization methods that rely on estimating second order statistics often fail when the number of samples of the recorded data sequences is small in comparison to the number of electrodes. This condition is particularly relevant when measuring evoked potentials. Due to the correlated background EEG/MEG signal, an adaptive approach to localization is desirable. Previous work has addressed these issues by reducing the adaptive degrees of freedom (DoFs). This reduction results in decreased resolution and accuracy of the estimated source configuration. This paper develops and tests a new multistage adaptive processing technique based on the minimum variance beamformer for brain source localization that has been previously used in the radar statistical signal processing context. This processing, referred to as the fast fully adaptive (FFA) approach, can significantly reduce the required sample support, while still preserving all available DoFs. To demonstrate the performance of the FFA approach in the limited data scenario, simulation and experimental results are compared with two previous beamforming approaches; *i.e.*, the fully adaptive minimum variance beamforming (MVB)** Error! Reference source not found. **method and the Beamspace beamforming method** Error! Reference source not found.-Error! Reference source not found.**. Both simulation and experimental results demonstrate that the FFA method can localize all types of brain activity more accurately than the other approaches with limited data.**

***Index Terms*— Electroencephalogram, magnetoencephalogram, brain source localization, beamforming, evoked potentials, fast fully adaptive processing.**