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Multi-channel analysis for gradient artifact removal from concurrent EEG-fMRI studies

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ABSTRACT

Concurrent electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) recordings are susceptible to large amounts of noise due to the static and dynamic magnetic fields present inside the MR scanner. EEG-fMRI studies are conducted to provide better spatial and temporal resolution for each recording, respectively, but the artifacts found in the EEG render the data impossible to interpret. Past studies have focused on signal post-processing techniques which are able to effectively remove noise upon the completion of a study, but there are no techniques able to process the data in real-time without extensive calibration. This research addresses this issue by exploring multi-channel analysis techniques on data combined from each of the EEG channels with a limited number of epochs. In particular, the spatial dependency between the three orthogonal components of the magnetic field gradients was studied to find corresponding templates that can be used to remove this artifact. The resulting algorithms were then tested against an existing algorithm to evaluate their performance. The multi-channel average artifact regression algorithm was found to be robust against the motion artifact and functioned well with few epochs. This algorithm has been implemented in a MATLAB toolbox which will soon be available to the public. Further studies are needed to extend this approach to remove the pulse artifact.

KEYWORDS

EEG-fMRI, Gradient artifact, Multi-channel