

Impact of automated EEG denoising on dementia classification performance

Camille Marchal^{1,2}, Victor Férat³, Tomas Ros^{1,2}

¹ Center for Biomedical Imaging (CIBM), Geneva-Lausanne, Switzerland

² Department of Clinical Neuroscience, University of Geneva, Geneva, Switzerland

³ M/EEG Platform, Campus Biotech, Geneva, Switzerland

Electroencephalography (EEG) has emerged as a promising tool for dementia research due to its non-invasive nature, low cost, and sensitivity to functional brain alterations. However, EEG signals are highly susceptible to physiological and environmental artifacts, which may compromise the reliability of extracted biomarkers and the performance of machine learning models. In this study, we investigated the impact of different automated denoising strategies on dementia classification outcomes.

Resting-state EEG recordings from an open-access dataset comprising 220 cognitively healthy controls and 221 patients with dementia were processed using five preprocessing pipelines: Raw EEG, ICLabel, Artifact Subspace Reconstruction (ASR), Multiple Artifact Rejection Algorithm (MARA), and Generalized Eigenvalue De-Artifacting Instrument (GEDAI). We extracted two established biomarker families, relative spectral power and EEG microstates, and trained Support Vector Machine classifiers using repeated 10-fold cross-validation.

Our results demonstrate that denoising substantially affects classification performance, with improvements of up to 16% depending on the biomarker considered. Among all evaluated methods, GEDAI consistently yielded the highest predictive accuracy, achieving AUC values of 0.84 for spectral power features and 0.74 for microstate features. These findings highlight preprocessing as a critical methodological factor in EEG-based dementia research and suggest that leadfield-informed denoising approaches may enhance the clinical utility and robustness of EEG biomarkers.

References

Kim, M., Youn, Y. C., & Paik, J. (2023). Deep learning-based EEG analysis to classify normal, mild cognitive impairment, and dementia: A review. *Ageing Research Reviews*, 86, 101654. Ros, T., Férat, V., Huang, Y., et al. (2025). Return of the GEDAI: Unsupervised EEG denoising based on leadfield filtering. *bioRxiv*. <https://doi.org/10.1101/2025.10.04.680494> Michel, C. M., & Koenig, T. (2018). EEG microstates as a tool for studying the temporal dynamics of whole-brain neuronal networks. *NeuroImage*, 180, 577–593