Iterative Filtering Decomposition Based Early Dementia Diagnosis Using EEG with Cognitive Tests

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Authors: Neelam Sharma, Maheshkumar H Kolekar, Kamlesh Jha

Abstract:

Objective: There has been a constant increase in life expectancy with the advancement of modern medicine. Likewise, dementia has also increased and projected to elevate in the coming decades with the higher expenditure on healthcare. Consequently, it is essential to identify early dementia, e.g., a patient suffering from mild cognitive impairment who is highly vulnerable to developing dementia soon.

Methods: Through this work, we brought forward an approach by fusing cognitive task and EEG signal processing. Continuous EEG of 16 dementia, 16 early dementia and 15 healthy subjects recorded under two resting states; eye open and eye closed, and two cognitive states; finger tapping test (FTT) and the continuous performance test (CPT). The present approach introduced iterative filtering (IF) as a decomposition technique for dementia diagnosis along with four significant EEG features power spectral density, variance, fractal dimension and Tsallis entropy. Multiclass classification conducted to compare the decision tree, k nearest neighbour (kNN), support vector machine, and ensemble classifiers.

Results: The proposed approach deeply checked for their capability of prediction using cognitive scores and EEG measures. The highest accuracies obtained by kNN with 10-fold cross-validation for dementia, early dementia and healthy are 92.00%, 91.67% and 91.87%, respectively.

Conclusion: The essential findings of this study are: 1) Experimental results indicate that kNN is superior over other classifier algorithms for dementia diagnosis. 2) CPT is the best predictor for healthy subjects. 3) FTT can be an essential test to diagnose significant dementia.

Significance: IF decomposition technique enhances the diagnostic accuracy even with a limited dataset.

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