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An Ensemble Based Incremental Learning Algorithm for Early Diagnosis, Confidence and Severity Estimation of Alzheimer's Disease

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As the number of the elderly population affected by Alzheimer's disease (AD) rise rapidly, the need to find an accurate, inexpensive and non-intrusive diagnostic procedure that can be made available to community healthcare providers is becoming an increasingly urgent public health concern. Several recent studies have looked at analyzing electroencephalogram (EEG) signals through the use of wavelets and neural networks. While showing great promise, the final outcomes of these studies have been largely inconclusive. This is mostly due to inherent difficulty of the problem, but also – perhaps – due to inefficient use of the available information, as many of these studies have used a single EEG source for the analysis. In our current effort, we investigate the feasibility of an ensemble of classifiers based data fusion approach to combine information from two or more sources, believed to contain complementary information, for early diagnosis of Alzheimer's disease. Our emphasis is on sequentially generating an ensemble of classifiers that explicitly seek the most discriminating information from each data source. Specifically, we use the event related potentials (ERPs) recorded from the Pz, Cz, and Fz electrodes of the EEG, decomposed into different frequency bands using multiresolution wavelet analysis. The proposed data fusion approach includes generating multiple classifiers trained with strategically selected subsets of the training data from each source, which are then combined through a modified weighted majority voting procedure. Surprising yet promising outcomes indicate that ERPs in response to novel sounds of oddball paradigm may individually be more reliable as a biomarker than commonly used responses to target sounds, and a further improvement of diagnostic accuracy may be improved by intelligent combination of the two.