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CLASSIFICATION AND MEDICAL DIAGNOSIS OF SCALP EEG USING ARTIFICIAL NEURAL NETWORKS

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Abstract. *An automatic Artificial Neural Network-Aided Diagnosis (ANNAD) system is designed in this study for initial scalp EEG screening to establish whether a given subject is epileptic or not. A unique ANNAD-based decision-making process is devised to make this distinction by 1) computing all standard EEG parameters in both time and frequency domain and 2) determining which of these parameters will yield the optimal classifier. The temporal parameters include activity, mobility and complexity, and the frequency parameters include the spectral power in delta, theta, alpha, beta I and II, and gamma. A single layer perceptron was used to conduct this analysis without initially setting any conditions on the weight vector, but rather allowed for the random generation of these conditions, with as many trials as necessary. This is an important first step that confines the search space to only those EEG data that have a very high likelihood of being recorded from epileptic patients, significantly minimizing the time for accurate diagnosis. We have evaluated our system using 125 EEG files selected randomly from a database consisting of 10 subjects (5 non-epileptic and 5 epileptic). The proposed ANNAD system was capable of diagnosing subjects with epilepsy with an accuracy of 92.04% and a calculated F-measure of 93.39%.*

Keywords: Feature extraction, Artificial neural networks, Epileptic vs. non-epileptic EEG classification

1. **Introduction.** In epilepsy research, the development of algorithms to automate the detection of epileptiform activity from EEG has become a common line of investigation for many scientists due to its potential for improving disease diagnosis and treatment. An example of such efforts is presented in [1,2], where interictal spikes from EEG recordings are detected by using the Walsh Transform; the study by [3-5] compares different back propagation-based artificial neural networks (ANNs) to evaluate the best features for delineating electrodes that initiate a seizure; [6] proposes an implementation of nonlinear decision functions and identification of multidimensional classification domains to detect seizures; [7] uses EEG recordings during hand motor imagery in order to move a cursor to a target on a computer screen and [8] performs classification of EEG signals extracted during mental tasks for design of a Brain Machine Interface.

Furthermore, recent advances in artificial intelligence have benefited from the problem-solving capabilities of ANNs, as exemplified by the classification of sleep apnea syndrome [9] based on wavelet transforms and ANNs; classification of seizures [10] by determining