Performance Analysis of Deep Learning Algorithms for Classification of EEG Signals

Muhammet Cihat Mumcu*[1], Beray Ikinci [2], Elif Öztürk[2], Kubilay Ataş[2], Abdullah Güngör[2]

Abstract: Recording and analysing brain activity is an important field of study in neuroscience and medicine. Electroencephalography (EEG) is a popular non-invasive technology for recording brain activity with high time resolution. Electroencephalography (EEG) has many uses in medicine, neurology, and brain engineering. Classification of EEG signals is an important step for extracting meaningful information from these signals. Many applications rely heavily on classification, such as recognising specific brain functions or illness states, discriminating between cognitive processes, or monitoring the user's mental state. Traditional EEG classification approaches rely on statistical and machine learning algorithms to analyse retrieved information. However, these approaches may have limits in classification performance since they do not capture all of the signal's intricacy and linkages. Many methods have been developed to automatically classify EEG signals. These approaches identify non-redundant salient features from EEG time series data and feed them into a machine learning classification model. The majority of these methods extract characteristics from EEG time series utilising temporal components. The brain is a highly interconnected complex system with connections at numerous levels, including individual neurons, neuronal populations, and brain regions. These interactions, known as brain networks, are assumed to be the origin of the EEG signals collected on the scalp. As a result, a classification model that can use this network structure in the learning process may perform better.

In recent years, the tremendous success of deep learning algorithms has sparked a great deal of interest in the field of EEG signal classification. Deep learning employs artificial neural networks' multilayer structure to automatically extract features from data. Deep learning algorithms use several structures, including Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM). These algorithms perform better on complicated and high-dimensional data, and they have the potential to improve EEG signal classification accuracy. In this study, EEG waves were classified using various deep learning methods in MATLAB. The deep learning techniques employed are Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM). The data collection comprised EEG recordings of various brain activity.

Keywords: Electroencephalography, Signal Classification, Deep Learning Algorithms, Artificial Intelligence.

[1]**Address:** Istanbul Gelisim University, Gelisim Vocational School, İstanbul/Turkiye
[2]**Address:** Istanbul Gelisim University, Faculty of Engineering and Architecture, İstanbul/Turkiye

***Corresponding author**: mcmumcu@gelisim.edu.tr