

## **A Two-Stage Learning Convolutional Neural Network for Sleep Stage Classification Using a Filterbank and Single Feature**

### **ABSTRACT**

Sleep is an essential process for the body that helps to maintain its health and vitality. The first stage in the diagnosis and treatment of sleep disorders is sleep staging. Due to the complications in manual sleep staging by the physician, computer-aided sleep stage classification algorithms are gaining attention. In this study, a novel approach was introduced to extract distinctive representations from single-channel EEG signal for automatic sleep staging. Standard deviation as a single feature was extracted from the frequency subbands of EEG, which gave a comprehensive understanding of the signal and its activity within various frequency ranges for different sleep stages. The features formed the input space of the proposed two-stream convolutional neural network (CNN) for classification and two-stage learning was used to train the model that achieved improvements in terms of accuracy, reliability and robustness against traditional classifiers and conventional training method of the neural networks. For the performance evaluation, three well-known benchmark datasets including Sleep EDF, Sleep EDFx and DREAMS Subject were used. The proposed algorithm by utilizing simple and effective methods improved sleep stage classification results by achieving an overall accuracy of 93.48%, 93.14% and 83.55%, respectively. The introduced framework in this study has great potential for practical implementation on a home-based sleep staging device.