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Title	Transfer Learning for Classifying Motor Imagery EEG: A Comparative Study
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Abstract

Motor imagery (MI) is the cognitive process when a person imagines performing a specific movement of their body. The corresponding electroencephalographic (EEG) signals can be measured externally to the head using scalp electrodes. Such signals have been applied in healthcare brain-computer-interface (BCI) systems, for example, motor rehabilitation and prosthetics control. These systems convert different MI EEG input signals to directives, so their performances depend on the efficiency of the embedded signal classification algorithm.

In this paper we investigate the effectiveness of transfer learning in classifying the MI EEG data. The continuous wavelet transform (CWT) is used to construct the scalograms, which serve as the inputs to the deep learning structure.

The efficacies of five pre-trained networks--AlexNet, ResNet18, ResNet50, InceptionV3 and ShuffleNet--are evaluated on the BCI competition IV data set 2a. Binary (left hand vs. right hand) and four-class (left hand, right hand, both feet, and tongue) classifications are trained and tested using five-fold cross validation. The result indicates that using the CWT with transfer learning models provides very high classification accuracies. The ResNet18 network achieves the best accuracies in both cases at 95.03±2.95% and 91.86±2.90%, respectively.

In addition, we examine the effect of different time-frequency features on the classification performance by comparing the scalogram of the CWT and the spectogram of the short-time Fourier Transform (STFT) as the inputs. It is found that the CWT is the preferred choice as it is superior to the STFT.