EEG based Emotion Recognition using Convolutional Neural Network

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Method:

Emotion is one of the most central and pervasive aspects of human experience. Normal people 'feel' and 'express' a wide range of emotions. While emotions deepen and enrich human experience, they also have profound effect on other cognitive functions such as decision-making, reasoning, language comprehension, etc[1].

In the field of machine learning, Convolutional Neural Network (CNN) is considered the state-of-the-art model in image recognition tasks. CNN have been shown successfully in many applications such as face recognition[2], object classification[3] and scene descriptions[4]. The main reasons of this success are 1) advances in learning algorithms for deep architectures and 2) large labeled data sets such as ImageNet[5]. ImageNet is a huge dataset of hierarchical labeled images for the ImageNet Challenge.

In this paper, we aim at analyzing the ability of AlexNet[6] to classify topography images from EEG signals. The EEG signals are came from emotionally induced subjects. Our initial hypothesis was that well represented topography image improve the performance of CNN. Because, CNN is good at the image recognition problem. "AlexNet" is now a standard architecture known in the deep learning community and often used for benchmarking. It contains 5 convolutional layers, 3 of which are followed by max pooling layers, 2 fully connected layers, and 1 softmax layer. We used functions in the tensorflow tool to implement the "AlexNet". Figure 1 shows the structure of "AlexNet".

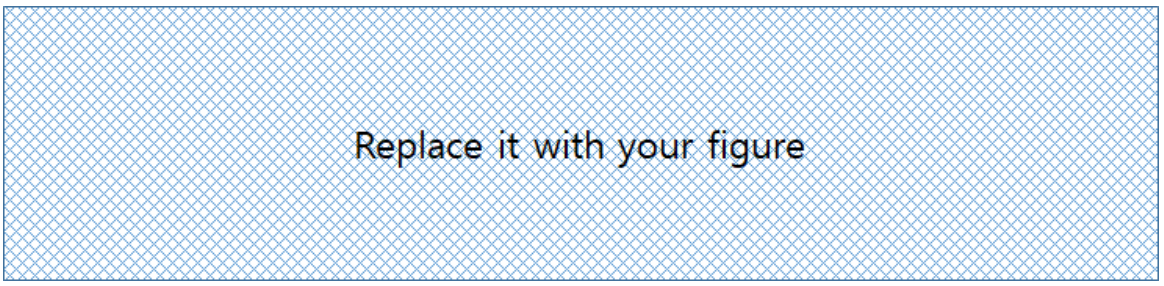

Fig 1. Structure of AlexNet[6]

Phase Locking Value (PLV) is adopted to extract EEG features. PLV is able to quantitatively measure the locking level on phase view of signal between two distant EEG electrodes[7]. There are two type of PLV computation methods. Depending on the applications, PLV across the total trials or Single-trial PLV is used feature[8]. In this study, we used Single-trial PLV (S-PLV) due to increase the number of sample size.

Experimental Results:

To compare the performance with other studies, we used the DEAP dataset which represents the benchmark for emotion classification research. The database was taken from [9] and included responses of 32 participants (seventeen males, fifteen females). Their mean age was 27.197 years (S.D.= 4.446). Generally, the results show that the state of the art classification accuracy of valence into 2 classes (high, low valence). The results of alpha frequency band (average training accuracy: 96.177 ± 3.467%, average test accuracy: 95.444 ± 2.905%) are better than the results of beta frequency band (average training accuracy: 94.037 ± 4.558%, average test accuracy: 93.993 ± 3.169%).

Keyword: Emotion recognition, EEG, Convolutional neural network, Phase locking value, Valence recognition
키워드: 감정 인식, 뇌전도, 합성곱 신경망, 위상 잠금치, 긍/부정도 인식

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