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# Emotion Recognition Using Spectral Feature from Facial Electromygraphy Signals for Human-Machine Interface

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Abstract. Recognition of the emotions demonstrated by human beings plays a crucial role in healthcare and human-machine interface. This paper reports an attempt to classify emotions using a spectral feature from facial electromyography (facial EMG) signals in the valence affective dimension. For this purpose, the facial EMG signals are obtained from the DEAP dataset. The signals are subjected to Short-Time Fourier Transform, and the peak frequency values are extracted from the signal in intervals of one second. Support vector machine (SVM) classifier is used for the classification of the features extracted. The extracted feature can classify the signals in the valence dimension with an accuracy of 61.37%. The proposed feature could be used as an added feature for emotion recognition, and this method of analysis could be extended to myoelectric control applications.

**Keywords.** Emotion Recognition, Facial electromyography, Human-Machine Interface

# 1. Introduction

Emotion detection is essential to interpret the various emotions expressed by human beings. It plays a vital role in many research areas, like healthcare and human-machine interface (HMI). Analysis of Facial Electromyography (EMG) signals is fast becoming a preferred method for emotion detection [2]. In this work, an attempt has been made to classify human beings' emotional states using the time-frequency domain features obtained from the facial EMG signals.

### 2. Methodology

The pre-processed data from the DEAP dataset [1] is used for this study. Thirty-two healthy subjects volunteered during the preparation of this dataset. The pre-trial baseline signal is removed, and the remaining length of the facial EMG signal is analysed. The signals are passed through a high-pass filter (passband cutoff frequency – 20 Hz) and a notch filter (notch at 50 Hz). Then, the filtered signals are subjected to the Short-Time

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Fourier Transform and the peak frequency (PF) values in intervals of one second throughout the signal are extracted.

$$PF = max(Power Spectrum_i), i = 1, 2, ..., L$$
 (1)

where L is the number of bins in the power spectrum.

The classification is done in the valence dimension, one of the four basic affective dimensions generally used for emotion recognition. The valence dimension is classified as positive valence (participant rating > 7) and negative valence (participant rating < 3). The classification is done using support vector machine (SVM) model and 10-fold cross-validation method.

### 3. Results and Discussions

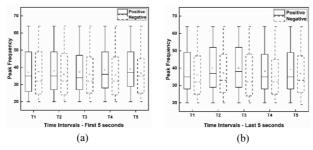


Figure 1. Peak Frequency values from STFT (a) First five seconds, (b) Last five seconds

Figure 1(a) represents the boxplot of peak frequency values obtained from the first five seconds, and figure 1(b) represents the boxplot of PF values obtained from the last five seconds. It is observed that there is a significant difference (p<0.05) in the peak frequency values in most of the time intervals, as observed in figure 1.

The SVM model achieved an accuracy of 61.37%, which can be considered suitable for classification in the valence dimension. The linear kernel gave the best accuracy compared to polynomial and RBF based kernel functions. The proposed feature could be used to develop better HMI for people with difficulties.

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