

Pleasant or Unpleasant? Human Emotion Detection Using EEG

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FIGURE 1

Acquisition protocol. Emotions are elicited by pleasant and unpleasant pictures of the International Affective Picture System.

FIGURE 2

Topographical maps (left) from both conditions in two different ranges of frequencies at 350 ms after stimulus onset. Relevance maps (right)

The recognition of emotions, in EEG, induced by the protocol shown in fig. 1, has been addressed with a signal processing and machine learning approach. As it is well-known, neuronal rhythms and the energy on the brain cortex fluctuate in different regions and vary along the time depending on the emotion we feel when we see pleasant or unpleasant images. The topographical maps in fig. 2 show an example of this for two frequencies (α and β) at 350 ms after stimulus onset, where it is evident the differences in beta activation. Hence, this is why it is important to search for an optimal method to extract the most relevant features for distinguishing distinct affective reactions.

The system aims to be used either in intra- or inter-subject applications. The difference between both procedures is mostly related with the input signals: intra-subject studies deal with single-trial signals for studying the behavior from only one participant, whereas inter-subject studies deal with ensemble averaged signals computed for each stimulus category and every participant.

Inter- and intra-subject methodologies fit well on different scenarios. The former is suitable for off-line applications to complement some information and establish bridges between machine learning approaches and univariate statistical tests widely used in analysis on brain neurophysiology. For instance, a robust classifier, known as support vector machine (SVM) was implemented into a wrapped scheme to identify the scalp spectral dynamics of interest linked to the emotional process, using the available signals from different EEG channels to form the input for the classifier. The wrapper strategy for feature elimination was carried out in order to improve the accuracy and identify the most discriminant features (see fig 2- right).

On the other side, due to the biological variability and the individual differences influence, intra-subject approaches are rather interesting for personalized studies where longitudinal evolution is essential and must be followed over sessions, such as in a rehabilitation therapy, emotional monitoring in psychiatric disorders or for neurofeedback-based applications. However, the system could be applied for recreational purposes as videogames adaptation as well.

