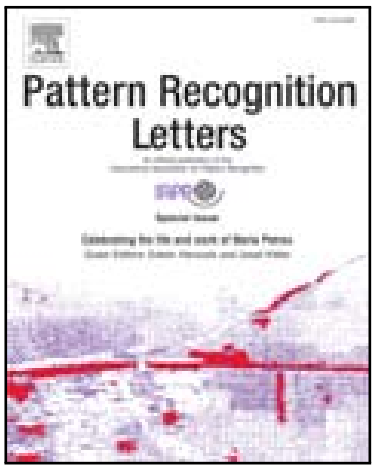

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Reinforcement Online Learning for Emotion Prediction by Using Physiological Signals

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ABSTRACT

Physiological signals generated from human internal organs can objectively and truly reflect the real-time variations of human emotion and monitor body situation. Recently, with the accessibility of a massive number of physiological signal data, emotion analysis by using physiological signals is attracting an increasing attention and many methods have been reported by using electroencephalogram (EEG) or peripheral physiological signals. Although the prominent online learning methods can predict the emotion status with time varying physiological signals, it does not consider the reward of current operation in each iteration. To tackle this problem, in this paper, we propose a reinforcement online learning (ROL) method for real-time emotion state prediction by exploiting the reward to modify the predictor during the online training iterations. In each iteration, we evaluate the reward and then select some specific instances into predictor learning. It gains both significant time reduction and prominent performance. We apply the reinforcement online learning to least squares (LS) and support vector regression (SVR) for Emotion Prediction, respectively. Extensive experiments are conducted on artificial dataset and real-world physiological signal dataset (DEAP dataset) and the experimental results validate the effectiveness of the proposed method.

1. Introduction

As a psycho-physiological process, emotion is a direct reflection of human conscious or unconscious perception of an object or situation. It plays an important role in people's interaction with each other. Recently, there is an increasing interest for the development of human's emotion-state recognition techniques [11, 5, 24]in human activities. The function of these techniques is improving [19, 32]. In addition, the target of affective computing is to detect emotions during human-computer interaction and synthesize emotional responses. Generally, human emotion analysis could be categories into several subtopics based on features that are applied for human affective recognition.

The first category is facial expression and voice [8, 9, 25, 4, 34, 33]. These techniques [6, 7] allow researchers to detect emotions from images or videos which have been recorded. Zheng [15] investigated the multi-view facial images for facial expressions. He also developed a novel group sparse reduced-rank regression (GSRRR) model for regression purpose. Some methods like robust technique can still work even if human subjects' facial images are hidden [26]. Jia et al. [16] built a macro-to-micro transformation model to enhance micro-expression features by transfering macro-expression learning to micro-expression. Ben et al. [1] proposed a tensor subspace analysis algorithm based on maximum margin projection for micro-expression recognition.

The second kind of approaches focus on body movements or human gestures [19, 2, 20]. It usually utilizes a small set of body movements such as gestures, walking, waving. Karg et al. [19] summarized recognition and generation reports on movements which convey affective expressions. Kleinsmith et al. [2] explored works on affective body recognition. They also used body expressions as input modality for automatic emotion recognition. However, A common movement notation system still needs to be built, which could be used for facilitating the affect-expressive movements and recognizing emotions of the action that a person is doing [2].

Physiological signal based emotion analysis is another kind of approaches for emotion analysis. It allows researchers to

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