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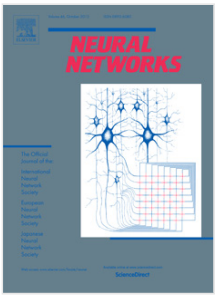

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Learning to decode human emotions with Echo State Networks

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Abstract.

The aim of this paper is to identify the common neural signatures based on which the positive and negative valence of human emotions across multiple subjects can be reliably discriminated. The brain activity is observed via Event Related Potentials (ERPs). ERPs are transient components in the Electroencephalography (EEG) generated in response to a stimulus. ERPs were collected while subjects were viewing images with positive or negative emotional content. Building inter-subject discrimination models is a challenging problem due to the high ERPs variability between individuals. We propose to solve this problem with the aid of the Echo State Networks **(**ESN) as a general framework for extracting the most relevant discriminative features between multiple subjects. The original feature vector is mapped into the reservoir feature space defined by the number of the reservoir equilibrium states. The dominant features are extracted iteratively from low dimensional combinations of reservoir states. The relevance of the new feature space was validated by experiments with standard supervised and unsupervised machine learning techniques.

From one side this proof of concept application enhances the usability context of the reservoir computing for high dimensional static data representations by low-dimensional feature transformation as functions of the reservoir states. From other side, the proposed solution for emotion valence detection across subjects is suitable for brain studies as a complement to statistical methods. This problem is important because such decision making systems constitute "virtual sensors" of hidden emotional states, which are useful in psychology science research and clinical applications.

Keywords: Echo State Networks, reservoir computing, feature selection, affective computing, Event Related Potentials