Rapid Adaptation of Brain Reading Interfaces based on Threshold Adjustment

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Abstract. Brain Reading Interfaces (BRIs) can be used, e.g., to detect whether a user has recognized or missed an infrequent but task-relevant warning. Machine learning allows to train an electroencephalography-based BRI such that it can distinguish between the two corresponding brain patterns. Unfortunately, acquiring a sufficient number of training examples is time-consuming since infrequent warnings cannot be displayed often and its not under the BRI's control how often a user misses a warning. Because of that, we propose to train the BRI instead on data associated with the recognition of an important warning and data associated with the perception of an irrelevant stimulus. Since irrelevant stimuli can be displayed with a higher frequency, large amounts of training data can be acquired more easily. We show that a BRI trained for this different but related task (the "source" task) can surprisingly well distinguish between recognized and missed warnings (the "target" task). This may indicate that similar brain patterns are evoked by missed warnings and irrelevant stimuli. To improve performance further, we propose to adjust the threshold which maps the scalar classifier output onto the two class labels in order to adapt the BRI from the source to the target task. A close-to-optimal threshold can be chosen based on a comparatively small training set from the target task. We show empirically on data acquired in the Labyrinth Oddball testbed (Kirchner et al. (2010)) that the proposed procedure is well-suited for rapid adaptation of the BRI to the target task based on a small amount of training data.

References

KIRCHNER, E. A., WÖHRLE, H., BERGATT, C., KIM, S. K., METZEN, J. H., FEESS, D. and KIRCHNER, F. (2010): Towards operator monitoring via brain reading - an EEG-based approach for space applications. *Proceedings of the 10th International Symposium on Artificial Intelligence, Robotics and Automation in Space (iSAIRAS)*, pp. 448-455, Sapporo, Japan

Keywords

BRAIN READING INTERFACE, THRESHOLD ADJUSTMENT