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Comparison of session-to-session transfer between old and recent session data in motor imagery BCI

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Introduction: Zero training is an important issue in brain-computer interface (BCI), as it minimizes the time-consuming calibration phase in a user-oriented system. Typical approaches transfer pre-existing session data to new session data to reduce the difference between sessions [1-2]. In previous work [3], we proposed a new strategy that used on-site background noise and outperformed existing feature extractors. We showed improved session-to-session transfer using a regularized spatio-temporal filter (RSTF) and a bias correction (BC) without any new session data; however, we did not investigate fully when BC is significantly effective. In this paper, a comparative study was performed on session-to-session transfer between very old pre-existing data (over 3 months old) and data collected recently (within a month).

Materials, Methods and Results: We compared classification accuracies and classifier outputs for pre-existing (more than three months) and recent (within a month) session data using RSTF with offline (background noise from pre-existing data) and on-site noise, and RSTF with on-site noise and BC. For the pre-existing data condition, we tested 6 multi-session data from 3 subjects, and for the recent data condition, 14 multi-session data from 12 subjects were tested. Results showed that RSTF with on-site noise suppression was useful for classification accuracy in both the pre-existing and recent conditions (Figure 1-A), and output results (Figure 1-B). RSTF with on-site noise and BC showed significant improvement in performance in the pre-existing data condition only.

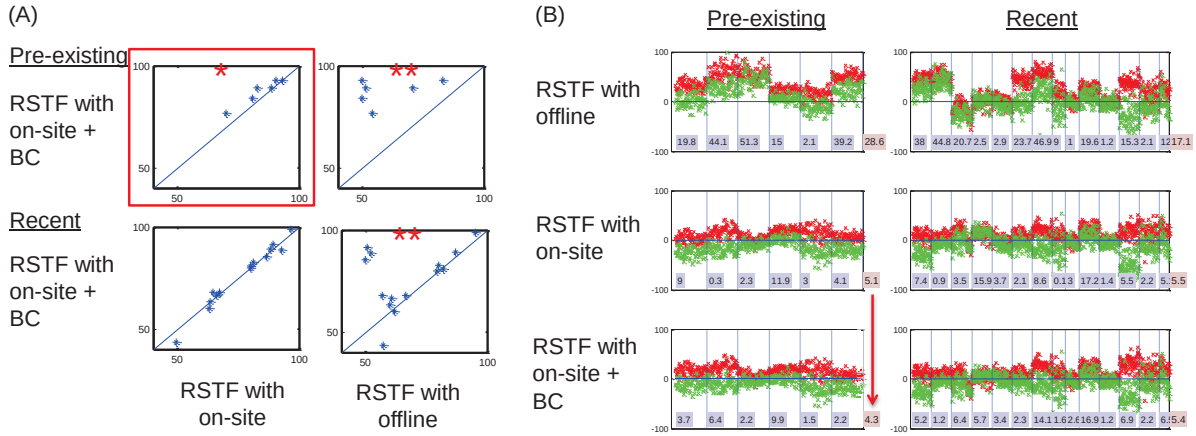

Figure 1. Comparison of three approaches to classification accuracy (A) and classifier outputs (B) with pre-existing (more than three months) and recent (within a month) session data. (A) Statistically significant pairs are marked with * (p<0.10) and ** (p<0.05). (B) Red and green dots indicate classifier outputs of different classes. Blue-shaded values are degrees of bias and red-shaded values indicate the mean of the degrees of bias defined in the equation.

Discussion: The bias correction method considers the Kullback Leibler distance between two different sources of background noise [3] and showed improved performance in the pre-existing data condition. It is likely that these interval sessions have a different spatial structure, while recent interval sessions do not.

Significance: Our proposed method showed improved session-to-session transfer for pre-existing session data more than three months old simply by using on-site background noise acquisition without new session data.

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References

[1] Krauledat M, Tangermann M, Blankertz B and Müller KR. Towards zero training for brain–computer interfacing. *PLoS One*, 3 e2967, 2008.
[2] Li X, Guan C, Zhang H, Ang KK and Ong SH. Adaptation of motor imagery EEG classification model based on tensor decomposition. *Journal of Neural Engineering,* 11 056020, 2014.
[3] Cho H, Ahn M, and Jun SC. Increasing session-to-session transfer in a brain–computer interface with on-site background noise acquisition. *Journal of Neural Engineering*, 12 066009, 2015.