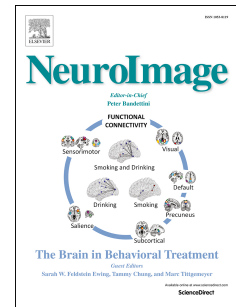


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A Subject-Transfer Framework for Obviating Inter- and Intra-Subject Variability in EEG-Based Drowsiness Detection

Chun-Shu Wei^{a,b,c}, Yuan-Pin Lin^d, Yu-Te Wang^{a,b}, Chin-Teng Lin^e, Tzyy-Ping Jung^{a,b,c,*}

^aDepartment of Bioengineering, University of California San Diego, La Jolla, CA, USA

^bSwartz Center for Computational Neuroscience, Institute for Neural Computation, University of California San Diego, La Jolla, CA, USA

^cCenter for Advanced Neurological Engineering, Institute of Engineering in Medicine, University of California San Diego, La Jolla, CA, USA

^dInstitute of Medical Science and Technology, National Sun Yat-Sen University, Kaohsiung, Taiwan

^eCentre for Artificial Intelligence, FEIT, University of Technology, Sydney, Australia

Abstract

Inter- and intra-subject variability pose a major challenge to decoding human brain activity in brain-computer interfaces (BCIs) based on non-invasive electroencephalogram (EEG). Conventionally, a time-consuming and laborious training procedure is performed on each new user to collect sufficient individualized data, hindering the applications of BCIs on monitoring brain states (e.g. drowsiness) in real-world settings. This study proposes applying hierarchical clustering to assess the inter- and intra-subject variability within a large-scale dataset of EEG collected in a simulated driving task, and validates the feasibility of transferring EEG-based drowsiness-detection models across subjects. A subject-transfer framework is thus developed for detecting drowsiness based on a large-scale model pool from other subjects and a small amount of alert baseline calibration data from a new user. The model pool ensures the availability of positive model transferring, whereas the alert baseline data serve as a selector of decoding models in the pool. Compared with the conventional within-subject approach, the proposed framework remarkably reduced the required calibration time for a new user by 90% (18.00 min to 1.72 ± 0.36 min) without compromising performance ($p = 0.0910$) when sufficient existing data are available. These findings suggest a practical pathway toward plug-and-play drowsiness detection and can ignite numerous real-world BCI applications.

* Corresponding author.

E-mail address: jung@scn.ucsd.edu (T.-P. Jung).

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