

Abstract

The mental workload and multitasking capacity of an individual is an important consideration for operator and workplace safety assessment. Developing ways to understand and accurately assess mental workload is therefore essential. In this thesis, we study multitasking mental workload elicited from the simultaneous capacity (SIMKAP) psychology test, measured with the electroencephalograph (EEG) signal. Beginning with the individual specific case, we propose novel feature based methods for classification, drawing inspiration from previous work and psychophysiology. We then study general underlying neural mechanics of multitasking through EEG spectral analysis of the SIMKAP test and propose a subject independent classification model based on questionnaire ratings. Next, we consider generalization capability by transferring models trained on SIMKAP to classify a separate workload dataset and show that a novel 2-level autoencoder structure is able to learn features for stable transfer classification performance. Finally, we show applications developed for multitasking assessment and neurofeedback training.

Publication List

W. L. Lim, O. Sourina and L. P. Wang, "STEW: Simultaneous Task EEG Workload Dataset", in *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 2018.

W. L. Lim, O. Sourina and L. P. Wang, "Cross Dataset Workload Classification Using Encoded Wavelet Decomposition Features", in *2018 International Conference on Cyberworlds (CW)*, 2018.

W. L. Lim, Y. Liu, S. H. Subramaniam, H. P. Liew, G. Krishnan, O. Sourina, D. Konovessis, H. E. Ang and L. P. Wang, "EEG-based Mental Workload and Stress Monitoring of Crew Members in Maritime Virtual Simulator", in *Transactions on Computational Science*, 2018.

W. L. Lim, O. Sourina, L. P. Wang and Y. Liu, "Individual Alpha Peak Frequency Based Features For Subject Dependent EEG Workload Classification" in *IEEE International Conference on Systems, Man and Cybernetics (SMC)*, 2016, pp. 3329-3333.

O. Sourina, Y. Liu, X. Hou, W. L. Lim, W. Mueller-Wittig, L. P. Wang, D. Konovessis, C. H. Chen and W. T. Ang, "Neuroscience Based Design: Fundamentals and Applications," in *2016 International Conference on Cyberworlds (CW)*, 2016, pp. 250-257.

X. Hou, Y. Liu, W. L. Lim, Z. Lan, O. Sourina, W. Mueller-Wittig and L. P. Wang, "CogniMeter: EEG-based brain states monitoring," *Transactions on Computational Science XXVIII*, ed: Springer, 2016, pp. 108-126.

Y. Liu, W. L. Lim, X. Hou, O. Sourina, and L. P. Wang, "Prediction of Human Cognitive Abilities based on EEG Measurements," in *2015 International Conference on Cyberworlds (CW)*, 2015, pp. 161-164.

W. L. Lim, O. Sourina, and L. P. Wang, "MIND-An EEG Neurofeedback Multitasking Game," in *2015 International Conference on Cyberworlds (CW)*, 2015, pp. 169-172.

W. L. Lim, O. Sourina, L. P. Wang and Y. Liu, "EEG-based Mental Workload Recognition Related to Multitasking" in *International Conference on Information, Communications and Signal Processing (ICICS)*, 2015, pp. 1-4.

O. Sourina, X. Hou, L. P. Wang, W. L. Lim, and Y. Liu, "Neurofeedback games for the enhancement of cognitive abilities related to multitasking," *International Journal of Psychophysiology*, vol. 2, p. 149, 2014.