EEG-based Stress Recognition through the Integration of Convolutional Neural Networks and Mixture of Experts Ensemble Modelling

Ziqing XIA [a], Justin JiXi WEN [a], Chun-Hsien CHEN [a], Meng-Hsueh HSIEH [a,1], and Jo-Yu KUO [b]

[a] *School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore 639798, Singapore*
[b] *Department of Industrial Design, National Taipei University of Technology, Taipei City, 10608 Taiwan*

Abstract. Vessel Traffic Service Operators (VTSOs) are responsible for ensuring the safe and efficient operation of waterways. They use a Vessel Traffic Management System (VTMS) to provide real-time information and ensure the smooth flow of vessel traffic. However, the demanding nature of their work can lead to stress, which can impact their performance and lead to physical and mental health problems. To alleviate stress on VTSOs and reduce the risk of maritime accidents, investment in stress management technologies is important. In this study, we propose a novel machine learning model called 3D Mixture of Experts Convolutional Neural Network (3DMoEConvNet) to predict stress level for VTSOs based on their EEG signals. The 3DMoEConvNet model combines the strengths of 3D Convolutional Neural Network (3D CNN) and Mixture of Experts (MoE) architecture to effectively capture both the spatial and temporal features of EEG data, while also addressing the issue of individual differences in EEG data. The 3DMoEConvNet achieved accuracies of 99.80%, 99.80% and 99.84% for 2-Class, 3-Class and 4-Class predictions, respectively. The proposed model provides a basis for the advancement of EEG-based stress detection systems.

Keywords. Stress, electroencephalogram (EEG), neural network, individual difference, mixture of experts

---

[1] Corresponding Author, Mail: menghsueh.hsieh@ntu.edu.sg