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Emotion Recognition using EEG Signals and Machine Learning Approach



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Abstract

This study explores how EEG signals can be used to recognize human emotional states. After preprocessing, a feature-selection method was applied to provide a more effective representation of the signals for the model. The results show steady classification performance and highlight the important role of feature selection in improving emotion-recognition accuracy.

Keywords : EEG Signals; Emotion Recognition; Feature Selection; Machine Learning; Arousal–Valence

Introduction

In this study, EEG signals were used as the primary data source for the analysis. Following initial preprocessing and filtering, the signals were subjected to systematic feature-extraction and feature-selection procedures. All analytical stages, including the development of the machine-learning model, were performed using MATLAB.

Materials and method

In this study, EEG signals were used as the primary data source and underwent general preprocessing to prepare them for analysis. Channels with stronger associations to emotional responses were selected for further processing. Temporal, spectral, wavelet-based, and fractal features were then extracted from the prepared signals. A feature-selection method based on the Binary Grey Wolf Optimizer was applied to obtain a compact and informative feature set. The selected features were used to train and evaluate a machine-learning classifier. Classification was performed using the XGBoost algorithm with five-fold cross-validation. All processing and modeling procedures were carried out in MATLAB.

Results and Discussion

After applying the BGWO-based feature selection, the classification model achieved an accuracy of approximately 66% for the Arousal dimension and about 78% for the Valence dimension. These results indicate that the selected features were effective in capturing meaningful components of the EEG signals associated with emotional states. The analysis shows that the final feature set provided sufficiently informative input for the classifier, enabling more reliable differentiation between emotional conditions. Overall, combining feature selection with machine-learning classification offers an effective and stable framework for EEG-based emotion recognition and provides a reliable basis for future developments in this field.

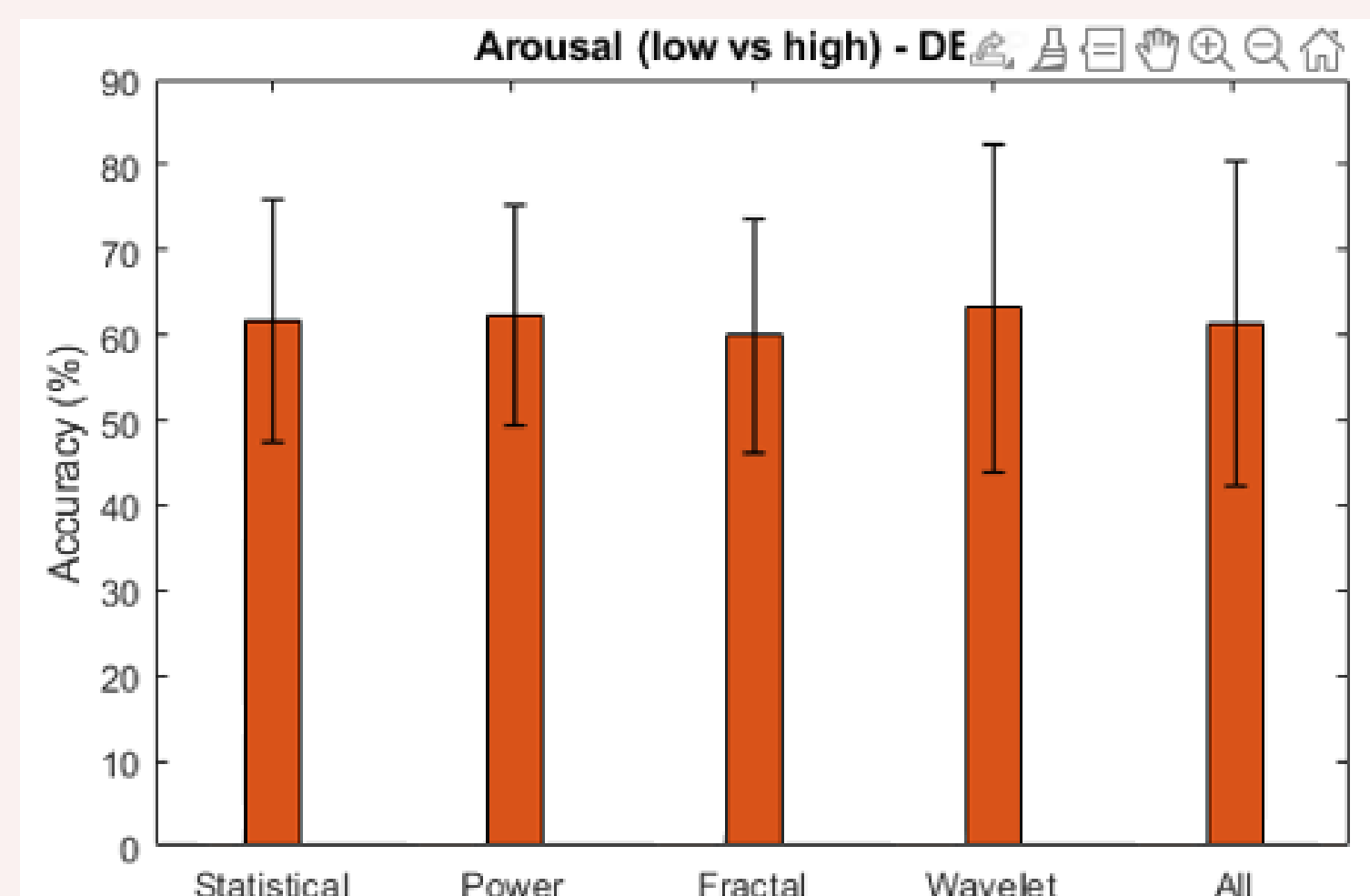


Fig. 1 Feature Extraction – Arousal

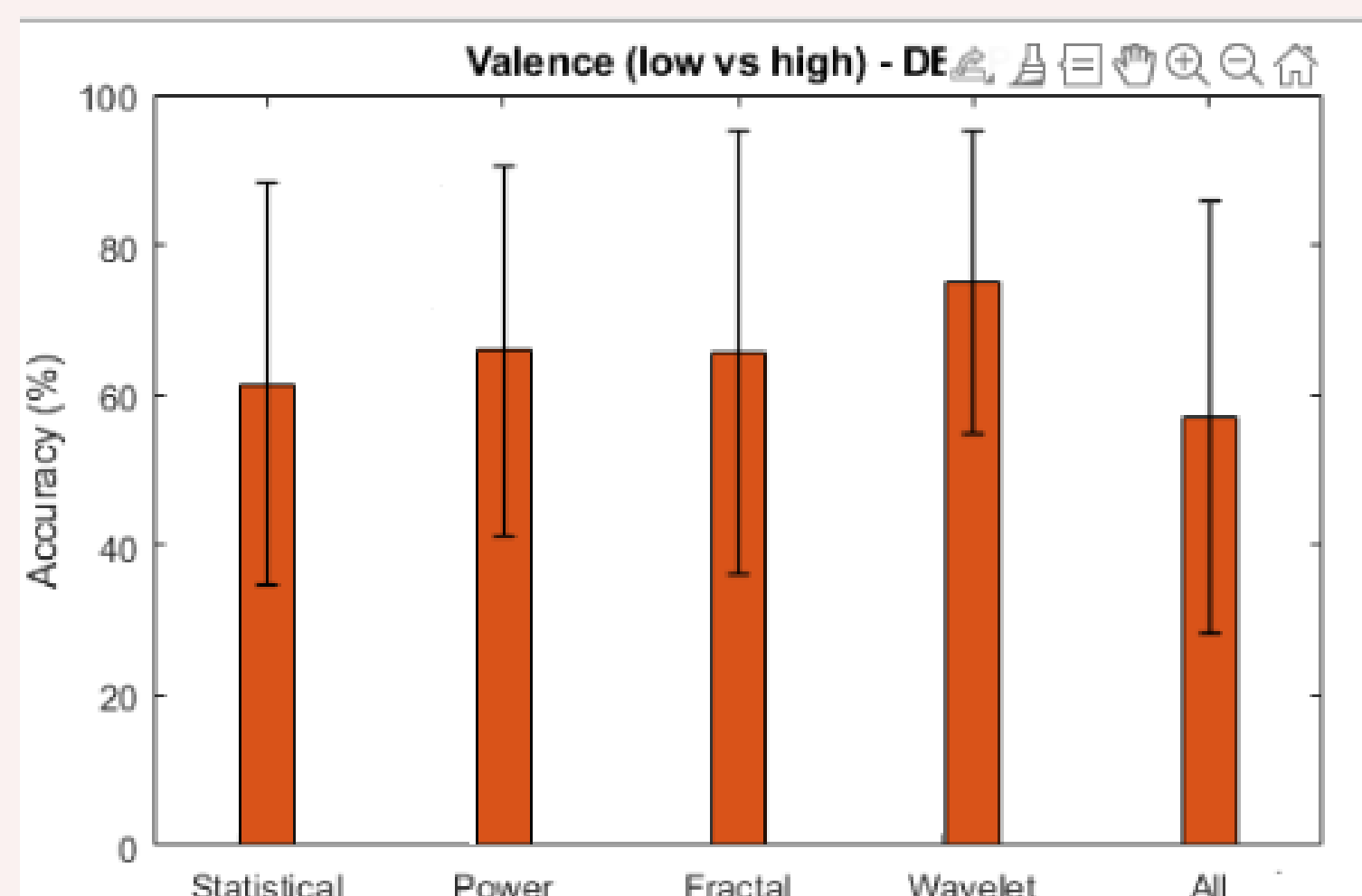


Fig. 2 Feature Extraction - Valence

Conclusions

This study presents a hybrid approach for EEG-based emotion recognition by integrating feature selection with machine-learning classification. The framework enables more reliable emotion recognition by focusing on informative EEG features and offering insight into related neural patterns.

References

- [1]. S. Koelstra et al., "Deap: A database for emotion analysis; using physiological signals," IEEE transactions on affective computing, vol. 3, no. 1, pp. 18–31, 2011.
- [2]. H. Asemi and N. Farajzadeh, "Improving EEG signal-based emotion recognition using a hybrid GWO-XGBoost feature selection method," Biomedical Signal Processing and Control, vol. 99, p. 106795, 2025.
- [3]. E. S. Salama, R. A. El-Khoribi, M. E. Shoman, and M. A. W. Shalaby, "A 3D-convolutional neural network framework with ensemble learning techniques for multi-modal emotion recognition," Egyptian Informatics Journal, vol. 22, no. 2, pp. 167–176, 2021.
- [4]. R. Nawaz, K. H. Cheah, H. Nisar, and V. V. Yap, "Comparison of different feature extraction methods for EEG-based emotion recognition," Biocybernetics and Biomedical Engineering, vol. 40, no. 3, pp. 910–926, 2020.
- [5]. P. Sarma and S. Barma, "Emotion recognition by distinguishing appropriate EEG segments based on random matrix theory," Biomedical Signal Processing and Control, vol. 70, p. 102991, 2021.
- [6]. B. Almarri, S. Rajasekaran, and C.-H. Huang, "Automatic subject-specific spatiotemporal feature selection for subject-independent affective BCI," Plos one, vol. 16, no. 8, p. e0253383, 2021.
- [7]. D. Nath, Anubhav, M. Singh, D. Sethia, D. Kalra, and S. Indu, "A comparative study of subject-dependent and subject-independent strategies for EEG-based emotion recognition using LSTM network," in Proceedings of the 2020 4th International Conference on Compute and Data Analysis, 2020, pp. 142–147.

Approval