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Mental Stress Classification Based on Selected Electroencephalography Channels Using Correlation Coefficient of Hjorth Parameters

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Abstract
Electroencephalography (EEG) signals offer invaluable insights into diverse activities of the human brain, including the intricate physiological and psychological responses associated with mental stress. A major challenge, however, is accurately identifying mental stress while mitigating the limitations associated with a large number of EEG channels. Such limitations encompass computational complexity, potential overfitting, and the prolonged setup time for electrode placement, all of which can hinder practical applications. To address these challenges, this study presents the novel CCHP method, aimed at identifying and ranking commonly optimal EEG channels based on their sensitivity to the mental stress state. This method's uniqueness lies in its ability not only to find common channels, but also to prioritize them according to their responsiveness to stress, ensuring consistency across subjects and making it potentially transformative for real-world applications. From our rigorous examinations, eight channels emerged as universally optimal in detecting stress variances across participants. Leveraging features from the time, frequency, and time–frequency domains of these channels, and employing machine learning algorithms, notably RLDA, SVM, and KNN, our approach achieved a remarkable accuracy of 81.56% with the SVM algorithm outperforming existing methodologies. The implications of this research are profound, offering a stepping stone toward the development of real-time stress detection devices, and consequently, enabling clinicians to make more informed therapeutic decisions based on comprehensive brain activity monitoring. © 2023 by the authors.

Author Keywords
channel selection; EEG; Hjorth parameters; machine learning; stress recognition

Index Keywords
adult, algorithm, article, brain function, controlled study, correlation coefficient, electroencephalography, human, machine learning, mental stress

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