FUNCTION–STRUCTURAL INTERACTION WITH MULTI-LEVEL FEATURE FUSION FOR ADHD CLASSIFICATION

Author's: M. Priyadharshini[1], S. Rajeshkumar[2], K. Sujith[3], N. Vanjulavalli[4]

Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a complex neurodevelopmental condition characterized by alterations in both functional and structural brain connectivity. Accurate classification of ADHD using neuroimaging data remains challenging due to the heterogeneous nature of the disorder and the intricate relationships between functional and structural brain features. This study proposes a novel framework based on Functional–Structural Interaction with Progressive and Multi-Level Feature Fusion for ADHD classification. The proposed method integrates functional connectivity features derived from functional magnetic resonance imaging (fMRI) and structural features extracted from structural MRI (sMRI) to capture complementary neurological information. A progressive fusion strategy is employed to hierarchically combine features at multiple levels, enhancing the representation of discriminative patterns. Additionally, the framework models interaction mechanisms between functional and structural domains to improve feature correlation and reduce redundancy. Advanced machine learning classifiers are utilized to learn fused representations and distinguish ADHD subjects from healthy controls. Experimental results demonstrate that the proposed multi-level fusion approach significantly improves classification accuracy, sensitivity, and specificity compared to conventional single-modality and basic fusion methods. The findings highlight the effectiveness of integrating functional–structural interactions and progressive feature fusion in enhancing diagnostic performance, providing a reliable and robust tool for early ADHD detection and clinical decision support.