Identification of Novel Diagnostic Neuroimaging Biomarkers for Autism Spectrum Disorder Through Convolutional Neural Network-Based Analysis of Functional, Structural, and Diffusion Tensor Imaging Data Towards Enhanced Autism Diagnosis

Adhikary, Annie (School: Nikola Tesla STEM High School)

Autism Spectrum Disorder is one of the leading neurodevelopmental disorders in our world, present in over 1% of the population and rapidly increasing in prevalence, yet the condition lacks a robust, objective, and efficient diagnostic. Clinical diagnostic criteria relies on subjective behavioral assessments, which are prone to misdiagnosis as they face limitations in terms of their heterogeneity, specificity, and biases. This study proposes a novel convolutional-neural-network based classification tool that aims to identify the potential of different neuroimaging features as autism biomarkers. The model is constructed using a set of sequential layers specifically designed to extract relevant features from brain scans. Trained and tested on over 300,000 distinct features across three imaging types, the model shows promising results, achieving an accuracy of 95.4% and outperforming metrics of current gold standard diagnostics. 32 optimal features from the imaging data were identified and classified as candidate biomarkers using an independent samples t-test, in which functional features such as neural activity and connectivity in various brain regions exhibited the highest differences in the mean values between individuals with autism and typical control subjects. The p-values of these biomarkers were < 0.001, proving the statistical significance of the results and indicating that this research could pave the way towards the usage of neuroimaging in conjunction with behavioral criteria in clinics. Furthermore, the salient features discovered in the brain structure of individuals with autism could lead to a more profound understanding of the underlying neurobiological mechanisms of the disorder, which remains one of the most substantial enigmas in the field even today.

Awards Won:

Third Award of $1,000

University of Texas at Dallas: Scholarship of $5,000 per year, renewable for up to four years