Abstract

Machine learning is changing the field of medical imaging. Studying complex neurological diseases like epilepsy can substantially benefit from its use. It can offer valuable insight onto the disease characteristics and also train predictive models to be used in various applications. Using both imaging and neuropsychological data provided by the Epilepsy Connectome Project, this work explores using machine learning to study temporal lobe epilepsy population in three steps. First, it exploits the feature extraction ability of machine learning to find that the frequency range between 0.1 – 0.073Hz is best at capturing abnormal resting-state functional connectivity in temporal lobe epilepsy compared to healthy controls, and that the impaired processing speed is the most informative among other neuropsychological tests in separating between the two groups. Second, it builds machine learning classification and regression models that can make various predictions on temporal lobe epilepsy patients. One finding reveals that temporal lobe epilepsy patients exhibit functional brains that are predicted to be on average 8.3 years older compared to their chronological ages. Third, the relationship between the sample size and binary classification accuracy is systematically explored using neuroimaging data. A number of guidelines are proposed for future research, as well as an equation for the sample size relationship that can be used to predict future accuracies given limited samples. Finally, it ends with suggestions of future research directions. Overall, this work presents how machine learning can facilitate epilepsy research and suggests ways that the limited sample size problems can be addressed.